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(54)【発明の名称】　偏光素子、光学素子、照明装置及び液晶表示装置

(57)【要約】

【課題】　複屈折が可及的に小さい支持基材を用いた偏光素子による光利用効率の高さや虹ムラの低さを維持しつつ、強度や耐熱性や耐湿性等の諸物性に優れる延伸フィルムなどの製造方法や利用形態等に応じた支持基材を用いうる偏光素子を開発し、輝度や視認性に優れる液晶表示装置を得ること。

【解決手段】　面内の遅相軸と進相軸及び厚さの各方向の屈折率をn_S、n_f、n_Zとしたとき、式：（n_S-n_Z）／（n_S-n_f）によるNzが２．５以下の複屈折性基材（１）の上に１層又は２層以上のコレステリック液晶ポリマー層からなる円偏光分離層（２）を有する偏光素子、その素子の円偏光分離層上に１層又は２層以上の位相差層からなる１／４波長板を有する光学素子、裏面に反射層を有する面光源上に前記の偏光素子又は光学素子をその円偏光分離層側を介して有する照明装置、及びその照明装置の光出射側に偏光板を介して液晶セルを有する液晶表示装置。

【特許請求の範囲】
【請求項１】　面内の遅相軸と進相軸の各方向の屈折率をｎｓ、ｎｆとし、厚さ方向の屈折率をｎｚとしたとき、式：（ｎｓ－ｎｚ）／（ｎｓ－ｎｆ）で定義されるＮｚが２．５以下の複屈折性基材の上に、１層又は２層以上のコレステリック液晶ポリマー層からなる円偏光分離層を有することを特徴とする偏光素子。
【請求項２】　請求項１において、複屈折性基材が、前項で定義の（ｎｓ－ｎｆ）が０．０７以上のものである偏光素子。
【請求項３】　請求項１又は２において、複屈折性基材が延伸又は非延伸のポリマーフィルムからなる偏光素子。
【請求項４】　請求項３において、フィルムがポリオレフィン系、ノルボルネン系、ポリエステル系、ポリイミド系、ポリカーボネート系、ポリエーテルスルホン系、ポリスルホン系、セルロース系、ポリアリレート系、ポリアクリル系又はエポキシ系のポリマーからなる偏光素子。
【請求項５】　請求項１～４に記載の偏光素子における円偏光分離層の上に、１層又は２層以上の位相差層からなる１／４波長板を有することを特徴とする光学素子。
【請求項６】　請求項５において、１／４波長板が少なくとも１層の液晶ポリマーからなる位相差層を有するものである光学素子。
【請求項７】　請求項６において、液晶ポリマーが捻じれ配向したものである光学素子。
【請求項８】　請求項５～７において、１／４波長板の上方に二色性物質含有の偏光板を有する光学素子。
【請求項９】　裏面に反射層を有する面光源上に、請求項１～４に記載の偏光素子又は請求項５～８に記載の光学素子をその円偏光分離層側を介して有することを特徴とする照明装置。
【請求項１０】　請求項９において、少なくとも１層のプリズムアレイ層を有する照明装置。
【請求項１１】　請求項１０において、２層以上のプリズムアレイ層を有し、それが上下の層でアレイの配列方向が交差した状態にある照明装置。
【請求項１２】　請求項９～１１に記載の照明装置の光出射側に、偏光板を介して液晶セルを有することを特徴とする液晶表示装置。
【請求項１３】　形成層の全部又は一部が接着層を介し積層されてなる請求項１～４に記載の偏光素子、請求項５～８に記載の光学素子、請求項９～１１に記載の照明装置又は請求項１２に記載の液晶表示装置。
【発明の詳細な説明】
【０００１】
【発明の技術分野】本発明は、液晶表示装置等の輝度の向上などに好適な偏光素子、光学素子、照明装置に関する。
【０００２】
【発明の背景】支持基材上にコレステリック液晶ポリマーからなる円偏光分離層を設けてなる偏光素子を介し自然光を左右の円偏光に分離し、それを１／４波長板を介し直線偏光化して液晶セルに供給することにより液晶表示装置の輝度を向上させるシステムが提案されている。支持基材は、液晶ポリマー層の配向処理や補強等を目的に用いられる。
【０００３】従来、前記の支持基材としては、複屈折が可及的に小さいトリアセチルセルロースフィルムやガラス板が用いられていた。複屈折は、偏光状態を乱して光の利用効率を低下させると共に、支持基材を斜め透過した複屈折光が液晶表示に虹ムラを発生させて視認性を低下させる原因となるからである。しかしながら、ガラス板には易破損性、トリアセチルセルロースフィルムには吸湿性などの問題があるため偏光素子の作製時等にその厚さや取扱が規制され、製造方法や利用形態等が限定される問題点があった。
【０００４】
【発明の技術的課題】本発明は、複屈折が可及的に小さい支持基材を用いた偏光素子による光利用効率の高さや虹ムラの低さを維持しつつ、強度や耐熱性や耐湿性等の諸物性に優れる延伸フィルムなどの製造方法や利用形態等に応じた支持基材を用いうる偏光素子を開発し、輝度や視認性に優れる液晶表示装置を得ることを課題とする。
【０００５】
【課題の解決手段】本発明は、面内の遅相軸と進相軸の各方向の屈折率をｎｓ、ｎｆとし、厚さ方向の屈折率をｎｚとしたとき、式：（ｎｓ－ｎｚ）／（ｎｓ－ｎｆ）で定義されるＮｚが２．５以下の複屈折性基材の上に、１層又は２層以上のコレステリック液晶ポリマー層からなる円偏光分離層を有することを特徴とする偏光素子を提供するものである。
【０００６】また本発明は、前記の偏光素子における円偏光分離層の上に、１層又は２層以上の位相差層からなる１／４波長板、その上に必要に応じて二色性物質含有の偏光板を有することを特徴とする光学素子、及び裏面に反射層を有する面光源上に前記の偏光素子又は光学素子をその円偏光分離層側を介して有することを特徴とする照明装置、並びにその照明装置の光出射側に偏光板を介して液晶セルを有することを特徴とする液晶表示装置を提供するものである。
【０００７】
【発明の効果】本発明の偏光素子によれば、支持基材の大きい複屈折特性に基づいて円偏光分離層で反射されて支持基材に再入射した円偏光の偏光状態を解消することができ、その光を照明装置としたときに面光源裏面の反射層と円偏光分離層の間に閉じ込めて多重反射を介し円偏光分離層に繰り返し再入射させることができ、それを

光源光と共に利用して、複屈折が可及的に小さい支持基材を用いた偏光素子に略匹敵する光利用効率の高さや虹ムラの低さを達成することができる。前記偏光状態が解消されない複屈折性の支持基材では、上記した如く支持基材を斜め透過した複屈折光による虹ムラの発生で視認性が大きく低下し、また偏光状態の残存で円偏光分離層を透過しにくくなり、輝度の低下が大きくなる。

【０００８】一方、複屈折を許容したことにより、延伸フィルム等の強度や耐熱性や耐湿性等の目的とする物性を有する支持基材を適宜に選択して使用でき、支持基材を薄膜化することもできる。その結果、支持基材に基づく製造方法や利用形態等の規制が大幅に緩和されて、輝度や視認性に優れる液晶表示装置を製造効率よく安定して得ることができる。

【０００９】

【発明の実施形態】本発明の偏光素子は、面内の遅相軸と進相軸の各方向の屈折率をn_S、n_fとし、厚さ方向の屈折率をn_Zとしたとき、式：（n_S-n_Z）／（n_S-n_f）で定義されるNzが２．５以下の複屈折性基材の上に、１層又は２層以上のコレステリック液晶ポリマー層からなる円偏光分離層を有するものからなる。その例を図１、図２に例示した。１が複屈折性基材、２が円偏光分離層で２１，２２がそのコレステリック液晶ポリマー層である。なお３は支持基材である。

【００１０】本発明において用いる複屈折性基材は、面内の遅相軸と進相軸の各方向の屈折率をn_S、n_fとし、厚さ方向の屈折率をn_Zとしたとき、式：（n_S-n_Z）／（n_S-n_f）で定義されるNzが２．５以下のものである。これにより偏光状態を解消して円偏光分離層を透過しやすくしつつ、基材を斜め透過する光の複屈折光化による虹ムラの発生を防止して、正面及び斜め方向の広い視野角で良好な視認性を示す輝度に優れる液晶表示装置を形成することができる。

【００１１】斜め透過光による虹ムラの発生防止等の点より好ましい複屈折性基材は、前記Nzが２．２以下、就中２．０以下のものである。なお当該Nz値は、マイナスであることも許容する。また輝度の向上等の点よりは、前記で定義の（n_S-n_f）による複屈折率差が０．００１以上、就中０．０７以上、特に０．０９以上の複屈折性基材が好ましく用いうる。

【００１２】複屈折性基材は、前記の複屈折特性を示す適宜な材料にて形成でき、取扱性や薄膜性などの点よりはポリマーフィルムが好ましい。そのポリマーフィルムは、キャスティング法や押出法等の適宜な方式で形成したものであってよく、また１軸や２軸等の適宜な処理方式による延伸フィルムであってもよいし、非延伸のフィルムであってもよい。

【００１３】複屈折性基材における前記したNzや複屈折差等の特性制御は、基材の結晶性等の材質や厚さ、延伸倍率や延伸温度等の条件を変えることにより行うことができる。また厚さ方向の屈折率の制御は、例えばポリマーフィルムを熱収縮性フィルムとの接着下に加熱延伸する方式などにより行うことができる。

【００１４】複屈折性基材の厚さは、使用目的等に応じて適宜に決定しうるが一般には、強度や薄膜化などの点より、５～５００μm、就中１０～２００μm、特に１５～１５０μmとされる。なお複屈折性基材は、単層物である必要はなく、強度や耐熱性、液晶ポリマーの密着性の向上等の種々の目的で異種ポリマーをラミネートしたフィルムなどの如く複層物であってもよい。

【００１５】なお複屈折性基材を形成する前記のポリマーについては特に限定はなく、透明性に優れて均等な複屈折を示すものが好ましい。ちなみにそのポリマーの例としては、ポリエチレンやポリプロピレンの如きポリオレフィン系、ノルボルネン系、ポリエステル系、ポリイミド系、ポリカーボネート系、ポリエーテルスルホン系、ポリスルホン系、セルロース系、ポリアリレート系、ポリスチレン系、ポリビニルアルコール系、ポリ塩化ビニル系、ポリ塩化ビニリデン系、ポリアクリル系、ポリアミド系、エポキシ系、液晶ポリマー系のものなどがあげられる。就中、耐湿性、耐熱性、強度又は／及び薄膜性などの点よりポリオレフィン系やノルボルネン系、ポリエステル系やポリイミド系、ポリカーボネート系やポリエーテルスルホン系、ポリスルホン系やセルロース系、ポリアリレート系やポリアクリル系、エポキシ系のポリマーが好ましく用いうる。

【００１６】円偏光分離層は、自然光を反射と透過を介し左右の円偏光に分離するものであり、適宜なコレステリック液晶ポリマーを用いて形成することができる。コレステリック液晶ポリマーは、液晶層の重量効率や薄膜化の点、視角変化に対する光学特性の変化が小さく視野角の広い液晶表示装置を形成しうる点などで優れており、就中、選択反射の波長域の広さなどの点より複屈折の大きいものが好ましい。円偏光分離層は、１層又は２層以上のコレステリック液晶ポリマー層にて形成することができる。

【００１７】ちなみにコレステリック液晶ポリマーの例としては、液晶配向性を付与する共役性の直線状原子団（メソゲン）がポリマーの主鎖や側鎖に導入された主鎖型や側鎖型のものなどがあげられる。取扱性や実用温度での配向の安定性などの点よりは、ガラス転移温度が３０～１５０℃のコレステリック液晶ポリマーが好ましく用いうる。なお前記主鎖型のコレステリック液晶ポリマーの具体例としては、屈曲性を付与するスペーサ部を必要に応じ介してパラ置換環状化合物等からなるメソゲン基を結合した構造を有する、例えばポリエステル系やポリアミド系、ポリカーボネート系やポリエステルイミド系などのポリマーがあげられる。

【００１８】また側鎖型のコレステリック液晶ポリマーの具体例としては、ポリアクリレートやポリメタクリレ

ート、ポリシロキサンやポリマロネート等を主鎖骨格とし、側鎖として共役性の原子団からなるスペーサ部を必要に応じ介してパラ置換環状化合物等からなる低分子液晶化合物（メソゲン部）を有するもの、低分子カイラル剤含有のネマチック系液晶ポリマー、キラル成分導入の液晶ポリマー、ネマチック系とコレステリック系の混合液晶ポリマーなどがあげられる。

【００１９】前記の如く、例えばアゾメチン形やアゾ形、アゾキシ形やエステル形、ビフェニル形やフェニルシクロヘキサン形、ビシクロヘキサン形の如きパラ置換芳香族単位やパラ置換シクロヘキシル環単位などからなるネマチック配向性を付与するパラ置換環状化合物を有するものにても、不斉炭素を有する化合物等からなる適宜なキラル成分や低分子カイラル剤等を導入する方式などによりコレステリック配向性のものとすることができる（特開昭５５－２１４７９号公報、米国特許明細書第５３３２５２２号等）。なおパラ置換環状化合物におけるパラ位における末端置換基は、例えばシアノ基やアルキル基、アルコキシ基などの適宜なものであってよい。

【００２０】またスペーサ部としては、屈曲性を示す例えばポリメチレン鎖－（CH_2）$_n$－やポリオキシメチレン鎖－（CH_2CH_2O）$_m$－などがあげられる。スペーサ部を形成する構造単位の繰返し数は、メソゲン部の化学構造等により適宜に決定され、一般にはポリメチレン鎖の場合にはｎが０～２０、就中２～１２、ポリオキシメチレン鎖の場合にはｍが０～１０、就中１～３である。

【００２１】本発明の偏光素子は、図１、図２に例示の如く複屈折性基材１の上に１層又は２層以上のコレステリック液晶ポリマー層２１，２２からなる円偏光分離層２を有するものである。その形成は、例えば複屈折性基材とコレステリック液晶ポリマーのフィルムを必要に応じ接着層を介してラミネートする方法等にても行いうるが、一般には基材上にコレステリック液晶ポリマーを塗工付設する方法にて行われる。

【００２２】円偏光分離層は、コレステリック液晶ポリマーを配向処理することにより形成される。その配向処理は、従来の低分子液晶に準じた方法にて行いうる。ちなみにその例としては、基材上に設けたポリイミドやポリビニルアルコール等の膜をレーヨン布等でラビング処理したものやSiO_2の斜方蒸着層等からなる適宜な配向膜の上に、あるいは延伸等による配向フィルムの上に液晶ポリマーを展開してガラス転移温度以上、等方相転移温度未満に加熱し、液晶ポリマー分子がグランジャン配向した状態でガラス転移温度未満に冷却してガラス状態とし、当該配向が固定化された固化層を形成する方法などがあげられる。なお上記した液晶ポリマーのフィルムは、かかる固化層を基材より剥離することにより得ることができる。

【００２３】前記の液晶ポリマーの展開は、加熱溶融方式によってもよいし、溶剤による溶液として展開することもできる。その溶剤としては、例えば塩化メチレンやシクロヘキサノン、トリクロロエチレンやテトラクロロエタン、Ｎ－メチルピロリドンやテトラヒドロフランなどの適宜なものを用いうる。

【００２４】前記の展開は、スピンコート法やロールコート法、フローコート法やプリント法、ディップコート法や流延成膜法、バーコート法やグラビア印刷法等の適宜な方法で行うことができる。展開に際しては、必要に応じ配向膜を介したコレステリック液晶ポリマー層の重量方式なども採ることができる。

【００２５】コレステリック液晶ポリマー層の厚さは、配向の乱れや透過率低下の防止、選択反射性（円偏光二色性を示す波長範囲）などの点より、０．５～１００μｍ、就中１～５０μｍ、特に３～２０μｍが好ましい。なおコレステリック液晶ポリマー層の形成に際しては、安定剤や可塑剤や金属類などからなる種々の添加剤を必要に応じて配合することができる。

【００２６】円偏光分離層は、図２に例示の如く２層又は３層以上のコレステリック液晶ポリマー層２１，２２の重畳層として形成することもできる。重畳化は、分離機能の広波長域化や斜め入射光の波長シフトに対処する点等より有利であり、その場合には反射光の中心波長が異なる組合せで重畳することが好ましい。

【００２７】すなわち、単層のコレステリック液晶ポリマー層では通例、選択反射性（円偏光二色性）を示す波長域に限界があり、その限界は約１００nmの波長域に及ぶ広い範囲の場合もあるが、その波長範囲でも液晶表示装置等に適用する場合に望まれる可視光の全域には及ばないから、そのような場合に選択反射性の異なるコレステリック液晶ポリマー層を重畳させて円偏光二色性を示す波長域を拡大させることができる。

【００２８】ちなみに選択反射の中心波長が３００～９００nmのコレステリック液晶ポリマー層を同じ偏光方向の円偏光を反射する組合せで、かつ選択反射の中心波長が異なる組合せで用いて、その２～６種類を重畳することで可視光域をカバーできる円偏光分離層を効率的に形成することができる。

【００２９】なお前記の同じ偏光方向の円偏光を反射するものの組合せとする点は、各層で反射される円偏光の位相状態を揃えて各波長域で異なる偏光状態となることを防止し、利用できる状態の偏光の増量を目的とする。

【００３０】なお上記した如く、コレステリック液晶ポリマーとしては適宜なものを用いてよいが、位相差の大きい液晶ポリマーほど選択反射の波長域が広くなり、層数の軽減や大視野角時の波長シフトに対する余裕などの点より好ましく用いうる。また視角変化による色変化の角度依存性を低減する点よりは、選択反射の中心波長が短いものより順々に重畳し、その長波長側に１／４波長板を配置することが好ましい。

【００３１】前記したコレステリック液晶ポリマーにおける選択反射の中心波長の相違は、クランジャン配向の螺旋ピッチの相違に基づくが、本発明にては厚さ方向に螺旋ピッチが変化する円偏光分離層や、螺旋ピッチ相違の２層以上のコレステリック液晶ポリマー層が反射光の中心波長に基づいて長短の順序通りに重畳して厚さ方向に螺旋ピッチが変化する円偏光分離層などの適宜な形態の円偏光分離層であってよい。

【００３２】前記した螺旋ピッチが厚さ方向に変化する構造も選択反射の波長域の拡大などに有効である。その場合、同じ螺旋ピッチのコレステリック液晶ポリマー層間に、螺旋ピッチの異なるコレステリック液晶ポリマー層が前記中心波長の長短の順序通りに１層又は２層以上介在した形態のものの如く、同じ螺旋ピッチのコレステリック液晶ポリマー層を２層以上含む層構造なども許容される。

【００３３】なお上記した螺旋ピッチが厚さ方向に変化する円偏光分離層の製造は、例えば配向処理したコレステリック液晶ポリマー層同士の２枚又は３枚以上の所定数を熱圧着により接着する操作などにより行うことができる。熱圧着処理には、ロールラミネータ等の適宜な加熱押圧手段を介してコレステリック液晶ポリマー層をガラス転移温度以上、等方相転移温度未満に加熱して圧着処理する方式などの適宜な方式を採ることができる。

【００３４】基材との一体物からなる液晶ポリマーの固化層の場合には、その固化層同士が密接するように前記に準じて重畳処理することにより厚さ方向に螺旋ピッチが変化する円偏光分離層、ひいては本発明による偏光素子を得ることができる。

【００３５】前記の場合、図２に例示のように偏光素子の表裏などに２層以上の前記基材１，３が残存する場合には、複屈折性基材１以外の支持基材３は、トリアセチルセルロースフィルムやアモルファスポリオレフィンフィルムの如き複屈折による位相差が可及的に小さい従来に準じたものを用いることが視認性の維持などの点より好ましい。

【００３６】なお厚さ方向に螺旋ピッチが変化する円偏光分離層は、連続した反射光の波長域を示すものであってもよいし、不連続な反射光の波長域を示すものであってもよい。虹ムラ防止等の点より好ましい円偏光分離層は、連続した反射光の波長域を示すものである。

【００３７】前記の円偏光分離層の製造は、例えば上記した熱圧着操作等で形成したコレステリック液晶ポリマー層の重畳体をガラス転移温度以上、等方相転移温度未満に加熱して、その密着界面に上下の層を形成するコレステリック液晶ポリマーが混合した配向層を形成する方法などにより行うことができる。

【００３８】前記において、上下の層のコレステリック液晶ポリマーが混合して形成されたコレステリック液晶ポリマー層は、螺旋ピッチが上下の層とも異なって厚さ方向に螺旋ピッチが多段階に変化した円偏光分離層を形成し、通例その螺旋ピッチは上下の層を形成するコレステリック液晶ポリマー層の中間値をとって、上下の層と共に連続した反射光の波長域を示す領域を形成する。

【００３９】従って上下の層で反射光の波長域が重複しないコレステリック液晶ポリマー層の組合せ、すなわち反射光の波長域に不連続による欠落域が存在する組合せで用いた場合に、上下の層の混合により形成されたコレステリック液晶ポリマー層が前記欠落域を埋めて反射光の波長域を連続化することができる。

【００４０】よって例えば、反射波長域が５００nm以下のものと６００nm以上のものの２種のコレステリック液晶ポリマー層を用いて、反射波長域の不連続域である５００～６００nmの波長域の光についても反射する円偏光分離層を得ることができ、これは少ないコレステリック液晶ポリマー層の重畳で、広い帯域の反射波長域を示す円偏光分離層を形成しうることを意味する。

【００４１】本発明の偏光素子は、液晶表示装置の形成などに好ましく用いうる。その場合、偏光素子は、その少なくとも片面に１層又は２層以上の位相差層からなる１／４波長板を付加した光学素子として用いることもできる。光学素子の例を図３、図４に示した。４が１／４波長板で、４１，４２が位相差層である。さらに５は偏光板である。

【００４２】１／４波長板は、図３、図４に例示の如く円偏光分離層２を透過した円偏光を直線偏光化するためのものであり、１層又は２層以上の位相差層にて形成される。１／４波長板は、視角変化による色変化の角度依存性の低減などの点より円偏光分離層における反射光の中心波長の長波長側に配置することが好ましい。

【００４３】１／４波長板（位相差層）としては可視光域の場合、直線偏光化効果や斜め透過光による色変化の補償などの点より正面位相差が１００～１８０nmのものが好ましく用いられる。すなわち面内の最大屈折率をn_x、それに直交する方向の屈折率をn_y、厚さ方向の屈折率をn_z、厚さをｄとした場合に式：$(n_x-n_y)\,d=\Delta nd$＝１００～１８０nmを満足する１／４波長板が好ましく用いられる。

【００４４】前記１／４波長板機能を示す位相差層と共に必要に応じて用いられる位相差層は、１／４波長板機能を示す位相差層を斜め透過した光の色バランスを垂直透過した光の色バランスに可及的に一致させて、偏光板を介した視認をより色付きの少ない中間色とすることなどを目的とする補償用のものであり、正面位相差（Δnd）が１００～７２０nmものが好ましく用いられる。

【００４５】なお前記において色変化の補償等の点より好ましく用いうる位相差層は、厚さ方向の屈折率が面内方向の一方又は両方のそれよりも大きいもの、あるいは式：$(n_x-n_z)/(n_x-n_y)$で表されるNzが５以下、就中２以下、特に１．５以下（いずれもマイナス値

を許容する）のものである。

【００４６】位相差層は、任意な材質で形成してよく透明性に優れ、就中８０％以上の光透過率を示して均一な位相差を与えるものが好ましい。一般には上記の複屈折性基材で例示したポリマーからなる延伸フィルムや液晶ポリマー、就中、捩じれ配向の液晶ポリマーなどが用いられる。

【００４７】前記したΔｎｄやNzや厚さ方向の屈折率等の特性の制御は、上記した複屈折性基材の場合に準じて行いうる。位相差層の一般的な厚さは、単層物に基づき５～５００μm、就中１０～３００μm、特に２０～２００μmであるが、これに限定されない。

【００４８】なお１／４波長板等の位相差層を液晶ポリマーにて形成する場合には、上記した円偏光分離層の場合に準じて、液晶ポリマーの配向フィルムや透明基材で支持した液晶ポリマーの配向層などの適宜な形態を有するものとして得ることができる。液晶ポリマーを用いた場合には、延伸処理なしに目的の位相差層を形成することもできる。

【００４９】１／４波長板は、前記の如く単層の位相差層からなっていてもよいし、位相差が相違する２層又は３層以上の位相差層の重畳体からなっていてもよい。位相差が相違する位相差層の重畳化は、目的の１／４波長板や補償板として機能する波長範囲の拡大などに有効である。位相差層の重畳体とする場合、厚さ方向の屈折率が面内屈折率の少なくとも一方よりも高い位相差層を１層又は２層以上配置することが上記した点より好ましい。

【００５０】輝度の向上効果等の点より好ましい光学素子は、所定の偏光軸の直線偏光を透過し、それ以外の光を反射するものである。光学素子は、図４に例示の如く１／４波長板４の上方に、偏光板５を配置した形態とすることもできる。この場合には、別個の偏光板を用いることなくそのまま液晶セルに適用することができる。

【００５１】偏光板としては、二色性物質を含有させた吸収型偏光板やポリエン配向フィルム、あるいは当該フィルムに透明保護層を設けたものなどの適宜なものを用いうる。ちなみに吸収型偏光板の例としては、ポリビニルアルコール系フィルムや部分ホルマール化ポリビニルアルコール系フィルム、エチレン・酢酸ビニル共重合体系部分ケン化フィルムの如き親水性高分子フィルムに、ヨウ素や二色性染料等の二色性物質を吸着させて延伸したフィルムなどがあげられる。また、ポリエン配向フィルムの例としては、ポリビニルアルコールの脱水処理物やポリ塩化ビニルの脱塩酸処理物などがあげられる。なお偏光板の厚さは通例５～８０μmであるが、これに限定されない。

【００５２】液晶表示装置の形成には、明るい表示の達成性、すなわち１／４波長板を介し高度に直線偏光化された光を可及的に吸収ロスを防止しつつ偏光板を透過させて、液晶セルへの高度な直線偏光の入射による良好なコントラスト比の表示を得る点などより、二色性物質含有の吸収型偏光板などの如く偏光度の高いものが好ましく用いられる。就中、光透過率が４０％以上で、偏光度が９５．０％以上、特に９９％以上の二色性物質含有の吸収型偏光板が好ましく用いられる。

【００５３】前記の透明保護層は、特に二色性物質含有の偏光板の如く耐水性に乏しい場合などに保護目的で設けられるもので、プラスチックの塗布方式やフィルムとしたものの積層方式などの適宜な方式で形成してよい。フィルム等の分離物で形成する場合には、接着層で積層一体化することが反射ロスの防止等の点より好ましい。透明保護層の厚さは適宜に決定してよく、一般には１mm以下、就中５００μm以下、特に１～３００μmとされる。なおプラスチックとしては、適宜なものを用いてよく、上記の複屈折性基材等で例示のものなどがあげられる。

【００５４】なお透明樹脂層は、微粒子を含有させる方式などにて表面微細凹凸構造の形態に形成することもできる。その微粒子には、例えば平均粒径が０．５～５μmのシリカ、アルミナ、チタニア、ジルコニア、酸化錫、酸化インジウム、酸化カドミウム、酸化アンチモン等の導電性のこともある無機系微粒子や、架橋又は未架橋ポリマー等の有機系微粒子などの透明樹脂層中で透明性を示すものが用いられる。微粒子の含有量は２～２５重量%、就中５～２０重量%が一般的である。

【００５５】偏光板を１／４波長板の上側に配置するに際して、１／４波長板に対する偏光板の配置角度は、１／４波長板の位相差特性やそれに入射する円偏光の特性などに応じて適宜に決定しうるが、光利用効率の向上等の点より１／４波長板を介し直線偏光化された光の偏光方向（振動方向）に対し偏光板の透過軸を可及的に平行に配置することが好ましい。

【００５６】本発明の光学素子は、自然光等の光源からの光を反射と透過を介して左右の円偏光に分離する偏光素子を透過した円偏光や楕円偏光を１／４波長板で直線偏光化して偏光板等に供給しうるようにしたものである。従って図５、図６に例示した如く、かかる偏光素子や光学素子をサイドライト型導光板やＥＬランプなどの裏面に反射層を有する適宜な面光源６の上に配置して液晶表示装置のバックライト等として好適な照明装置を形成することができる。なお図例の面光源は、裏面に反射層６１を有する導光板６の側面に光源６２を配置してなる。

【００５７】前記図例の照明装置によれば、光源６２よりの光が導光板６の側面に入射し裏面等での反射を介して導光板の表面より出射し、その出射光は、導光板の表面側に配置した円偏光分離層２を所定の円偏光（垂直）や楕円偏光（斜め）として透過し、１／４波長板４を介し直線偏光化されて偏光板５に入射する。一方、所定外

の円偏光として円偏光分離層２で反射された光は、複屈折性基材１を介し偏光状態が解消された状態で導光板６に再入射して裏面に配置された反射層６１を介し反射され、戻り光として再び円偏光分離層２に入射する。

【００５８】前記の円偏光分離層による反射光は、複屈折性基材１を介し偏光状態が解消されてその一部、就中、約半分の反射光が円偏光分離層を透過しうる光となる。従って円偏光分離層による反射光は、その円偏光分離層を透過するまで円偏光分離層と導光板との間に閉じ込められて、それらの間で反射を繰り返す。

【００５９】前記の如くサイドライト型導光板では、反射光が円偏光分離層と導光板の反射層の間に閉じ込められ、その間で反射を繰り返す内に円偏光分離層を透過することとなり、光源からの入射光の初期透過光と共に出射されて、これにより反射ロスによる光の未利用分が低減される。

【００６０】一方、円偏光分離層より出射した光は１／４波長板を介して直線偏光や直線偏光成分の多い楕円偏光に変換され、この変換光はその直線偏光方向が偏光板の透過軸と合致したとき、殆ど吸収されずに偏光板を透過し、これにより吸収ロスによる光の未利用分も低減される。その結果、従来では反射ロスや吸収ロスとなっていた光も有効利用でき、光の利用効率を向上させることができる。従って面光源としてはサイドライト型の導光板が好ましく用いうる。

【００６１】前記の導光板としては、裏面に反射層を有して光を表面側に出射するようにした適宜なものを用いうる。好ましくは、光を吸収なく効率的に出射するものが用いられる。（冷，熱）陰極管等の線状光源や発光ダイオード等の光源を導光板６の側面に配置し、その導光板に導光板内を伝送される光を拡散や反射、回折や干渉等により板の片面側に出射するようにした、液晶表示装置で公知のサイドライト型バックライトなどはその例である。

【００６２】前記において、内部の伝送光を片面側に出射するようにした導光板は、例えば透明又は半透明の樹脂板の光出射面又はその裏面にドット状やストライプ状に拡散体を設けたものや、樹脂板の裏面に凹凸構造、就中、微細プリズムアレイ状の凹凸構造を付与したものなどとして得ることができる。

【００６３】なお導光板の裏面に設けた反射層６１は、偏光素子を介した戻り光の反射と共に、光源からの入射光が裏面より漏れることを防止して反射ロスをほぼ完全に防止する点などよりも有効である。反射層は、凹凸面等で代表される拡散反射層、アルミニウムや銀等の蒸着層、それを設けた樹脂板、金属箔などからなる金属面で代表される鏡面反射層などの適宜な反射面にて形成することができる。

【００６４】照明装置の形成に際しては、図６に例示の如く、光の出射方向を制御するためのプリズムシート等からなるプリズムアレイ層７、均一な発光を得るための拡散板、線状光源からの出射光を導光板の側面に導くための光源ホルダなどの補助手段を導光板６の上下面や側面などの所定位置に必要に応じ１層又は２層以上を配置して適宜な組合せ体とされる。

【００６５】前記において、導光板の表面側（光出射側）に配置したプリズムアレイ層や拡散板、あるいは導光板に付与したドットなどは拡散効果等で偏光状態の解消手段などとしても機能しうる。なお２層以上のプリズムアレイ層を配置する場合には、各層におけるプリズムアレイを直交ないし交差させるなどしてアレイの配置角度をずらせることにより、光学的異方性が解消される状態に配置することが好ましい。

【００６６】本発明において、偏光素子や光学素子や照明装置を形成する複屈折性基材や円偏光分離層、１／４波長板や偏光板や導光板等の各層は、必要に応じて接着層を介し積層一体化することができる。形成層の積層一体化は、各界面での反射ロスの抑制や各界面への異物等の侵入防止による表示品位等の低下予防、光学系のズレによる補償効率や偏光変換効率等の低下防止などに有効である。従って複屈折性基材や円偏光分離層、１／４波長板や偏光板や導光板等がそれぞれ複数の層で形成される場合にも、各層を接着層等を介して密着一体化することが好ましい。

【００６７】前記の積層一体化には適宜な接着剤等を用いうるが、就中、応力緩和性に優れる粘着層が、光源等からの熱で円偏光分離層や１／４波長板や偏光板等に生じる応力を抑制して、光弾性変形により発生する屈折率の変化を防止し、明るくて視認性や表示品位の信頼性に優れる液晶表示装置を形成する点などより好ましく用いうる。

【００６８】粘着層の形成には、例えばアクリル系重合体やシリコーン系ポリマー、ポリエステルやポリウレタン、ポリエーテルや合成ゴムなどの適宜なポリマーを用いてなる透明な粘着剤を用いうる。就中、光学的透明性や粘着特性、耐候性などの点よりアクリル系粘着剤が好ましく用いうる。

【００６９】また粘着層としては、熱により積層体内部に発生する内部応力の緩和による光弾性変形の防止性などの点より、緩和弾性率が2×10^{5}～1×10^{7}dyne／cm^2、就中2×10^{6}～8×10^{6}dyne／cm^{2}のものが好ましい。

【００７０】粘着層の厚さは適宜に決定してよい。一般には、接着力や薄型化等の点より１～５００μm、就中２～２００μm、特に５～１００μmとされる。なお粘着層には必要に応じて、石油系樹脂やロジン系樹脂、テルペン系樹脂やクマロンインデン系樹脂、フェノール系樹脂やキシレン系樹脂、アルキド系樹脂の如き粘着付与剤、フタル酸エステルやリン酸エステル、塩化パラフィンやポリブテン、ポリイソブチレンの如き軟化剤、ある

いはその他の各種充填剤や老化防止剤などの適宜な添加剤を配合することができる。

【００７１】積層一体化した光学素子等の形成は、例えばフィルム等の薄葉体を剥離剤で表面処理してなるセパレータ上に設けた粘着層を偏光素子の接着面に移着し、その上に１／４波長板を圧着し、さらにその１／４波長板上に粘着層を同様に移着し、その上に偏光板を配置して圧着する方式などがあげられる。

【００７２】また導光板等の接着面にセパレータ上に設けた粘着層を移着し、その上に偏光素子を配置して圧着した後、その上に粘着層を同様にして移着して１／４波長板や必要に応じての偏光板を順次圧着する方式、あるいは予め所定の接着面に設けた粘着層を介して偏光素子や１／４波長板、偏光板や導光板等の被着体を所定の順序で積層し、それをプレス処理して一括的に圧着する方式などもあげられる。

【００７３】本発明による偏光素子や光学素子、照明装置には、その表面や層間の適宜な位置に光拡散板などの適宜な光学層を配置することもできる。その場合、光学層は応力緩和性に優れる粘着層等を介して偏光素子等に積層一体化してもよい。かかる事前接着方式は、組立てラインにおける順次の接着方式よりも品質の安定した信頼性に優れる素子が得られるなどの利点を有している。

【００７４】なお本発明においては、偏光素子や光学素子、照明装置を形成する基材や液晶ポリマー層、１／４波長板や偏光板、導光板や接着層、その他の光学層等の部品を、例えばサリチル酸エステル系化合物、ベンゾフェノール系化合物、ベンゾトリアゾール系化合物、シアノアクリレート系化合物、ニッケル錯塩系化合物等の紫外線吸収剤で処理する方式などにより紫外線吸収能をもたせることもできる。

【００７５】上記のように本発明の偏光素子や光学素子は、サイドライト型導光板等の適宜な面光源との組合せで用いて、円偏光分離層による反射円偏光を偏光解消して出射光として再利用することで反射ロスを防止し、その出射光を１／４波長板を介し位相制御して偏光板透過性の直線偏光成分をリッチに含む状態に変換することで偏光板による吸収ロスを防止して輝度の向上をはかりうるようにしたものである。

【００７６】従って、光の利用効率に優れて偏光板を透過しやすい光を提供し、大面積化等も容易であることより液晶表示装置等におけるバックライトシステムなどとして種々の装置に好ましく用いうる。その場合、１／４波長板を出射した光を光源として利用する点よりは、直線偏光や楕円偏光の長径方向成分などとして偏光板を透過しうる直線偏光成分を６５％以上、就中７０％以上含むことが好ましい。

【００７７】本発明による照明装置をバックライトシステムに用いた液晶表示装置を図７、図８に例示した。これは、照明装置を形成する導光板６の光出射面側に、光学素子を介して液晶セル８を配置したものであり、液晶セル８は、図例の如く光学素子の１／４波長板４の側に配置される。なお図中、８１は偏光板、９は視認光拡散用の光拡散板である。

【００７８】本発明の光学素子や照明装置は、液晶セルの両側に偏光板を有する液晶表示装置の形成に特に好ましく用いることができる。なお１／４波長板の上側に偏光板を有する光学素子の場合には、液晶セルにおける光学素子を設ける側の偏光板は省略することができる。

【００７９】液晶表示装置は一般に、偏光板、液晶セル、バックライト、及び必要に応じての補償用位相差板等の構成部品を適宜に組立てて駆動回路を組込むことなどにより形成される。本発明においては上記の如く、液晶セルの視認背面側に１／４波長板側ないし偏光板側を介して光学素子又は照明装置を配置する点を除いて特に限定はなく従来に準じて形成することができるが、各構成部品は粘着層を介して接着一体化されていることが好ましい。

【００８０】また本発明の光学素子や照明装置は、偏光状態の光を入射させる必要のある液晶セル、例えばツイストネマチック液晶やスーパーツイストネマチック液晶を用いたものなどに好ましく用いうるが、非ツイスト系の液晶や二色性物質を液晶中に分散させたゲストホスト系の液晶、あるいは強誘電性液晶を用いたものなどにも用いうる。

【００８１】液晶表示装置の形成に際しては、例えば視認側の偏光板の上に設ける光拡散板やアンチグレア層、反射防止膜や保護層や保護板、あるいは液晶セルと視認側等の偏光板の間に設ける補償用位相差板などの適宜な光学層を適宜に配置することができる。

【００８２】前記の補償用位相差板は、複屈折の波長依存性などを補償して視認性を向上させることなどを目的とするものである。本発明においては、視認側又は／及びバックライト側の偏光板と液晶セルの間等に必要に応じて配置される。なお補償用位相差板としては、波長域などに応じて適宜なものを用いることができ、１層又は２層以上の位相差層の重畳層として形成されていてよい。補償用位相差板は、上記した１／４波長板で例示の延伸フィルムや液晶ポリマー層などとして得ることができる。

【００８３】

【実施例】

実施例１

ＰＥＴフィルムからなる厚さ２０μm、Ｎｚ１．９５、面内の複屈折率差０．０９０の延伸フィルムに設けたポリビニルアルコールラビング処理面（約０．１μm厚）に、アクリル系サーモトロピックコレステリック液晶ポリマーの２０重量％テトラヒドロフラン溶液をワイヤバーにて塗工し、１６０℃で５分間加熱配向処理したのち室温で放冷して、厚さ４μm、選択反射の波長域４５０

～５４０nmの右円偏光を反射する円偏光分離層を形成した。

【００８４】一方、前記に準じて複屈折を示さない厚さ５０μmの三酢酸セルロースフィルムのポリビニルアルコールラビング処理面上に、メソゲン比率の相違により選択反射の波長域が５７０～６５０nmで右円偏光を反射する厚さ４μmの円偏光分離層を形成し、その上に前記で得た円偏光分離層を液晶ポリマー層同士を重ねあわせて１３０℃のラミネートロールに導入し、液晶ポリマー層が密着した重畳体からなる選択反射の波長域が４５０～６５０nmの円偏光分離層を有する偏光素子を得た。

【００８５】ついで、ポリカーボネートの延伸フィルムからなる正面位相差が１４０nmの１／４波長板を厚さ２０μmのアクリル系粘着層を介し前記偏光素子の三酢酸セルロースフィルム側（円偏光分離層の螺旋ピッチの多きい側）に接着して光学素子を得たのち、それを前記偏光素子のＰＥＴ延伸フィルム側を介し面光源の上に配置し厚さ２０μmのアクリル系粘着層を介しプレス圧着して照明装置を得た。なお面光源は、裏面にドット印刷を施した厚さ４mmのアクリル系導光板の側面に直径３mmの冷陰極管を配置してアルミニウム蒸着フィルムにて包囲し、前記ドット下面に発泡ポリエステルフィルムからなる反射シートを設けたものからなる。

【００８６】実施例２

ＰＥＴ延伸フィルムに代えて、Ｎｚ１．１、面内の複屈折率差０．００１、正面位相差１１６nmの延伸ポリカーボネートフィルムを用いたほかは実施例１に準じて偏光素子、光学素子及び照明装置を得た。

【００８７】実施例３

ＰＥＴ延伸フィルムに代えて、Ｎｚ１．１、面内の複屈折率差０．００４５、正面位相差２７０nmの延伸ポリカーボネートフィルムを用いたほかは実施例１に準じて偏光素子、光学素子及び照明装置を得た。

【００８８】比較例１

ＰＥＴ延伸フィルムとして、Ｎｚ３．３、面内の複屈折率差０．０７３のものを用いたほかは実施例１に準じて偏光素子、光学素子及び照明装置を得た。

【００８９】比較例２

ＰＥＴ延伸フィルムに代えて、複屈折を示さない厚さ５０μmの三酢酸セルロースフィルムを用いたほかは実施例１に準じて偏光素子、光学素子及び照明装置を得た。従って偏光素子は、両面に同じ三酢酸セルロースフィルムを有するものからなる。

【００９０】評価試験

実施例、比較例で得た照明装置の光出射側に、両面に偏光板を有する市販のＴＦＴ液晶パネルを配置し、その正面（垂直）方向の輝度を測定（トプコン社製、ＢＭ－５）すると共に、正面から左右４５度の斜視方向にわたる視認性を目視観察した。なお液晶パネルの配置に際しては、１／４波長板の延伸軸と最寄り偏光板の延伸軸の交差角を４５度とした。

【００９１】前記の結果を次表に示した。

	実施例１	実施例２	実施例３	比較例１	比較例２
正面輝度(cd／m²)	３５３	３３３	３３０	３５４	３５３
視　認　性	良好	良好	良好	不良	良好

【図面の簡単な説明】

【図１】偏光素子例の断面図

【図２】他の偏光素子例の断面図

【図３】光学素子例の断面図

【図４】他の光学素子例の断面図

【図５】照明装置例の断面図

【図６】他の照明装置例の断面図

【図７】液晶表示装置例の断面図

【図８】他の液晶表示装置例の断面図

【符号の説明】

１：複屈折性基材

２：円偏光分離層

２１，２２：コレステリック液晶ポリマー層

３：支持基材

４：１／４波長板

４１，４２：位相差層

５：偏光板

６：導光板（面光源）

６１：反射層

６２：光源

７：プリズムアレイ層

８：液晶セル（液晶表示装置）

８１：偏光板

【図１】

【図３】

【図４】

【図２】


3
22
21
2
1

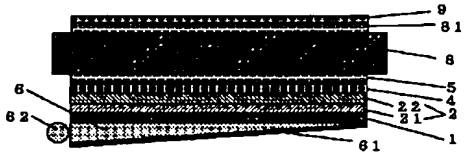
【図５】


6
62
4
22
21
2
1
61

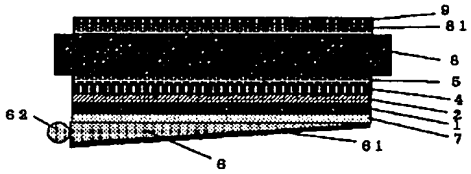
【図６】


8
62
7
4
2
1
61

【図７】


9
81
8
6
62
5
4
22
21
2
1
61

【図８】


9
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a.

PATENT ABSTRACTS OF JAPAN

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(54) POLARIZING ELEMENT, OPTICAL ELEMENT, ILLUMINATION DEVICE AND LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a liquid crystal display device having excellent luminance and visibility by developing a process for producing a stretched film, etc., having various excellent properties, such as strength, heat resistance and moisture resistance, while maintaining the highness of light utilization and low rainbow unevenness by a polarizing element using a supporting base material having the least possible double refraction and the polarizing element allowing the use of the supporting base material according the form of utilization, etc.

SOLUTION: This polarizing element has a circularly polarized light sepn. layer 2 consisting of one or ≥2 layers of cholesteric liquid crystal polymers on a double refractive base material 1 of <2.5 in N2 by the equation: (ns-nz)/(ns-nf) when the refractive indices in the respective directions of an intra-surface phase delay axis and phase advance axis and thickness are defined as ns, nf, nz. The element may otherwise have a quarter-wave plate consisting of one or ≥2 layers of phase difference layers on the circularly polarized light sepn. layer of the element. The illumination device has this polarizing element or optical element via this circularly polarized light sepn. layer side on a surface light source having a reflection layer on its rear surface. The liquid crystal display device has a liquid crystal cell via a polarizing plate on the

light exit side of the illumination device.

LEGAL STATUS

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[Date of final disposal for application]

[Patent number]

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[Date of extinction of right]

JAPANESE [JP,11-133231,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The polarizing element characterized by Nz defined by formula:(second-nz)/(second-nf) having the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer layer more than one layer or two-layer on 2.5 or less birefringence base material when the refractive index of each direction of the lagging axis within a field and a phase leading shaft is set to ns and nf and the refractive index of the thickness direction is set to nz.
[Claim 2] The polarizing element whose (second-nf) of a definition of a birefringence base material for the preceding clause is 0.07 or more things in claim 1.
[Claim 3] The polarizing element which a birefringence base material becomes from the polymer film of a drawing or not extending, in claim 1 or 2.
[Claim 4] The polarizing element which a film becomes from the polymer of a polyolefine system, a norbornene system, a polyester system, a polyimide system, a polycarbonate system, a polyether sulphone system, a polysulfone system, a cellulose type, a polyarylate system, the Pori acrylic, or an epoxy system in claim 3.
[Claim 5] The optical element characterized by having the quarter-wave length plate which consists of a phase contrast layer more than one layer or two-layer on the circular polarization of light detached core in a polarizing element according to claim 1 to 4.
[Claim 6] The optical element which is what has the phase contrast layer which a quarter-wave length plate becomes from the liquid crystal polymer of at least one layer in claim 5.
[Claim 7] The optical element which can twist a liquid crystal polymer and carries out orientation in claim 6.
[Claim 8] The optical element which has the polarizing plate of dichroism matter content above a quarter-wave length plate in claims 5-7.
[Claim 9] The lighting system characterized by having a polarizing element or an optical element according to claim 5 to 8 according to claim 1 to 4 through the circular polarization of light detached core side on the surface light source which has a reflecting layer at the rear face.
[Claim 10] The lighting system which has at least one-layer prism array layer in claim 9.
[Claim 11] The lighting system in the condition that have a prism array layer more than two-layer, and the array direction of an array crossed in the layer of it upper and lower sides in claim 10.
[Claim 12] The liquid crystal display characterized by having a liquid crystal cell through a polarizing plate in the optical outgoing radiation side of a lighting system according to claim 9 to 11.
[Claim 13] The polarizing element according to claim 1 to 4 to which it comes to carry out the laminating of all or the part through a glue line, the optical element according to claim 5 to 8, the lighting system according to claim 9 to 11, or the liquid crystal display according to claim 12 of the formative layer.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the suitable polarizing element for improvement in the brightness of a liquid crystal display etc., an optical element, and a lighting system.
[0002]
[Background of the Invention] It separates into the circular polarization of light of right and left of the natural light through the polarizing element which comes to prepare the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer on a support base material, and the system which raises the brightness of a liquid crystal display is proposed by linearly-polarized-light-izing it through a quarter-wave length plate, and supplying a liquid crystal cell. A support base material is used for the purpose of orientation processing, reinforcement, etc. of a liquid crystal polymer layer.
[0003] Conventionally, as the aforementioned support base material, a small triacetyl cellulose film and a small glass plate were used for the birefringence as much as possible. While a birefringence disturbs a polarization condition and reducing the utilization effectiveness of light, it is because it becomes the cause by which the birefringence light which carried out the slanting transparency of the support base material makes a liquid crystal display generate rainbow nonuniformity, and reduces visibility. However, since there were problems, such as hygroscopicity, in ******** and a triacetyl cellulose film at a glass plate, the thickness and handling were regulated at the time of production of a polarizing element etc., and there was a trouble that the manufacture approach, a utilization gestalt, etc. were limited.
[0004]
[The technical technical problem of invention] Maintaining the height of efficiency for light utilization and the lowness of rainbow nonuniformity by the polarizing element which used the small support base material as much as possible, this invention develops the polarizing element which can use the support base material according to the manufacture approaches, such as an oriented film which is excellent in many physical properties, such as reinforcement, thermal resistance, and moisture resistance, a utilization gestalt, etc., and a birefringence makes it a technical problem to obtain the liquid crystal display which is excellent in brightness or visibility.
[0005]
[Means for Solving the Problem] This invention offers the polarizing element characterized by Nz defined by formula:(second-nz)/(second-nf) having the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer layer more than one layer or two-layer on 2.5 or less birefringence base material, when the refractive index of each direction of the lagging axis within a field and a phase leading shaft is set to ns and nf and the refractive index of the thickness direction is set to nz.
[0006] Moreover, the quarter-wave length plate with which this invention consists of a phase contrast layer more than one layer or two-layer on the circular polarization of light detached

core in the aforementioned polarizing element, The optical element characterized by having the polarizing plate of dichroism matter content if needed on it, And the lighting system characterized by having an aforementioned polarizing element or an aforementioned optical element through the circular polarization of light detached core side on the surface light source which has a reflecting layer at the rear face, and the liquid crystal display characterized by having a liquid crystal cell through a polarizing plate at the optical outgoing radiation side of the lighting system in a list are offered.

[0007]

[Effect of the Invention] According to the polarizing element of this invention, the polarization condition of the circular polarization of light which it was reflected by the circular polarization of light detached core based on the large birefringence property of a support base material, and carried out re-incidence to the support base material is cancelable. When the light is used as a lighting system, can shut up between the reflecting layer on the rear face of the surface light source, and a circular polarization of light detached core, and can carry out re-incidence to a circular polarization of light detached core repeatedly through a multiple echo, and it is used with light source light. A birefringence can attain the height of efficiency for light utilization and the lowness of rainbow nonuniformity which carry out an abbreviation even match to the polarizing element using a small support base material as much as possible. In the support base material of birefringence with which said polarization condition is not canceled, as described above, visibility falls greatly by generating of the rainbow nonuniformity by the birefringence light which carried out the slanting transparency of the support base material, and it is hard coming to penetrate a circular polarization of light detached core by survival of a polarization condition, and lowering of brightness becomes large.

[0008] On the other hand, by having permitted the birefringence, the support base material which has the physical properties made into the objects, such as the reinforcement and thermal resistance of an oriented film etc., and moisture resistance, can be used choosing it suitably, and a support base material can also be thin-film-ized. consequently, the liquid crystal display which regulation of the manufacture approach based on a support base material, a utilization gestalt, etc. is substantially eased, and is excellent in brightness or visibility -- manufacture -- it is stabilized efficiently and can obtain.

[0009]

[Embodiment of the Invention] When the polarizing element of this invention sets the refractive index of each direction of the lagging axis within a field, and a phase leading shaft to ns and nf and the refractive index of the thickness direction is set to nz, Nz defined by formula:(second-nz)/(second-nf) has the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer layer more than one layer or two-layer on 2.5 or less birefringence base material. The example was illustrated to drawing 1 and drawing 2 . For 1, a birefringence base material and 2 are [21 and 22] the cholesteric-liquid-crystal polymer layer in a circular polarization of light detached core. In addition, 3 is a support base material.

[0010] When the birefringence base material used in this invention sets the refractive index of each direction of the lagging axis within a field, and a phase leading shaft to ns and nf and the refractive index of the thickness direction is set to nz, Nz defined by formula:(second-nz)/(second-nf) is 2.5 or less thing. Making a circular polarization of light detached core easy for this to cancel a polarization condition and to penetrate, generating of the rainbow nonuniformity by the formation of the double refracted light of the light which carries out the slanting transparency of the base material can be prevented, and the liquid crystal display which is excellent in the brightness which shows good visibility with the large angle of visibility of a transverse plane and the direction of slant can be formed.

[0011] Said Nz of a birefringence base material more desirable than points, such as generating prevention of the rainbow nonuniformity by the slanting transmitted light, is 2.0 or less thing above all 2.2 or less. In addition, that it is minus also permits the Nz value concerned. Moreover,

rather than points, such as improvement in brightness, 0.09 or more birefringence base materials can use [the double refractive-index difference by (second-nf) of the definition by the above] preferably especially 0.07 or more above all 0.001 or more.
[0012] A birefringence base material can be formed with the proper ingredient in which the aforementioned birefringence property is shown, and its polymer film is more desirable than points, such as handling nature and filminess. The polymer film may be formed by proper methods, such as the casting method and an extrusion method, and may be an oriented film by proper mode of processing, such as one shaft and biaxial, and may be a non-extending film.
[0013] The above mentioned property control of Nz, a birefringence difference, etc. in a birefringence base material can be performed by changing conditions, such as construction material of a base material, such as crystallinity, thickness and draw magnification, and drawing temperature. Moreover, the method which carries out the heating drawing for example, of the polymer film under adhesion with a heat shrink nature film can perform control of the refractive index of the thickness direction.
[0014] Although the thickness of a birefringence base material can be suitably determined according to the purpose of use etc., especially generally it is set to 15-150 micrometers 10-200 micrometers above all 5-500 micrometers from points, such as reinforcement and thin-film-izing. In addition, a birefringence base material does not need to be a monolayer object and may be double **** like the film which laminated the different-species polymer for the various object, such as reinforcement and improvement in thermal resistance and the adhesion of a liquid crystal polymer.
[0015] In addition, what especially definition does not have about the aforementioned polymer which forms a birefringence base material, is excellent in transparency, and shows an equal birefringence is desirable. Incidentally as an example of the polymer, the thing of the polyolefine system like polyethylene or polypropylene, a norbornene system, a polyester system, a polyimide system, a polycarbonate system, a polyether sulphone system, a polysulfone system, a cellulose type, a polyarylate system, a polystyrene system, a polyvinyl alcohol system, a polyvinyl chloride system, a polyvinylidene chloride system, the Pori acrylic, a polyamide system, an epoxy system, and a liquid crystal polymer system etc. is raised. Above all, the polymer of a polyolefine system, a norbornene system, a polyester system and a polyimide system, a polycarbonate system and a polyether sulphone system, a polysulfone system and a cellulose type, a polyarylate system, or the Pori acrylic and an epoxy system can use preferably from points, such as moisture resistance, thermal resistance, reinforcement, or/and filminess.
[0016] A circular polarization of light detached core can be divided into the circular polarization of light on either side through an echo and transparency, and can form the natural light using a proper cholesteric-liquid-crystal polymer. The cholesteric-liquid-crystal polymer is excellent in the superposition effectiveness of a liquid crystal layer, the point of thin-film-izing, the point that change of the optical property to viewing-angle change can form a small liquid crystal display with a large angle of visibility, etc., and its large thing of a birefringence is more desirable than points, such as a size of the wavelength region of selective reflection, above all. A circular polarization of light detached core can be formed in the cholesteric-liquid-crystal polymer layer more than one layer or two-layer.
[0017] Incidentally as an example of a cholesteric-liquid-crystal polymer, the thing of the principal chain mold with which the straight-line-like atomic group (meso gene) of the conjugate property which gives a liquid crystal stacking tendency was introduced into the principal chain and side chain of a polymer, or a side-chain mold etc. is raised. Rather than points, such as handling nature and the stability of the orientation in operating temperature, the cholesteric-liquid-crystal polymer whose glass transition temperature is 30-150 degrees C can use preferably. In addition, it has the structure which combined the meso gene radical which minds the spacer section which gives flexibility if needed as an example of said principal chain type of cholesteric-liquid-crystal polymer, and consists of a Para permutation ring compound

etc., for example, polymers, such as a polyester system, a polyamide system, a polycarbonate system, and a polyester imide system, are raised.
[0018] Moreover, a thing, a nematic system liquid crystal polymer of low-molecular chiral agent content, a liquid crystal polymer of chiral component installation, a mixed liquid crystal polymer of a nematic system and a cholesteric system, etc. which have the low-molecular-liquid-crystal compound (meso gene section) which makes polyacrylate, polymethacrylate, a polysiloxane, poly malonate, etc. a principal chain frame, minds the spacer section which consists of an atomic group of conjugate property as a side chain as an example of the cholesteric-liquid-crystal polymer of a side-chain mold if needed, and consists of a Para permutation ring compound etc. are raised.
[0019] Like the above, it can consider as the thing of a cholesteric stacking tendency with the method which introduces the proper chiral component which consists of a compound which has asymmetrical carbon also in what has the Para permutation ring compound which gives the nematic stacking tendency which consists of the Para permutation aromatic-series unit, the Para permutation cyclohexyl ring unit, etc. like for example, an azomethine form, an azo form, an AZOKISHI form and an ester form, a biphenyl form and a phenylcyclohexane form, and a bicyclo hexane form, a low-molecular chiral agent, etc. (JP,55-21479,A, U.S. Pat. No. 5332522, etc.). In addition, a cyano group, the alkyl group, alkoxy group of the end substituent in the para position in the Para permutation ring compound, etc. may be proper.
[0020] Moreover, as the spacer section, for example, polymethylene chain-(CH2) n-, polyoxymethylene chain-(CH2CH2O) m-, etc. which show flexibility are raised. the chemical structure of the meso gene section etc. determines suitably the number of cycles of the structural unit which forms the spacer section -- having -- general -- the case of a polymethylene chain -- n -- 0-20, and the case where they are 2-12, and a polyoxymethylene chain above all -- m -- 0-10 -- it is 1-3 above all.
[0021] The polarizing element of this invention has the circular polarization of light detached core 2 which becomes drawing 1 and drawing 2 from the cholesteric-liquid-crystal polymer layers 21 and 22 more than one layer or two-layer on the birefringence base material 1 like instantiation. Although the formation can be performed by the approach of laminating for example, a birefringence base material and the film of a cholesteric-liquid-crystal polymer through a glue line if needed etc., it is performed by the approach of generally carrying out the coating attachment of the cholesteric-liquid-crystal polymer on a base material.
[0022] A circular polarization of light detached core is formed by carrying out orientation processing of the cholesteric-liquid-crystal polymer. The orientation processing can be performed by the approach according to conventional low-molecular liquid crystal. Incidentally as the example, film prepared on the base material, such as polyimide and polyvinyl alcohol, on the proper orientation film which consists of what carried out rubbing processing with the rayon cloth etc., a method vacuum evaporationo layer of slanting of SiO2, etc. A liquid crystal polymer is developed on the oriented film by drawing etc. Or more than glass transition temperature It heats under to isotropic phase transition temperature, after the liquid crystal polymer molecule has carried out GURANJAN orientation, it cools under to glass transition temperature, and it considers as a vitreous state, and the approach of forming the flozen layer by which the orientation concerned was fixed etc. is raised. In addition, the above-mentioned film of a liquid crystal polymer can obtain this flozen layer by exfoliating from a base material.
[0023] Also with a heating melting method, expansion of the aforementioned liquid crystal polymer is good, and can also be developed as a solution by the solvent. As the solvent, proper things, such as a methylene chloride, a cyclohexanone and a trichloroethylene, tetrachloroethane and N-methyl pyrrolidone, and a tetrahydrofuran, can be used, for example.
[0024] The aforementioned expansion can be performed by proper approaches, such as a spin coat method, the roll coat method, the flow coat method and the printing method, a dip coating method and the flow casting forming-membranes method, the bar coat method, and gravure. On

the occasion of expansion, the superposition method of the cholesteric-liquid-crystal polymer layer which minded the orientation film if needed etc. can be taken.
[0025] Especially the thickness of a cholesteric-liquid-crystal polymer layer has above all 3-20 micrometers more desirable than points, such as turbulence of orientation, prevention of permeability lowering, and selective reflection nature (wavelength range which shows circular dichroism), 1-50 micrometers 0.5-100 micrometers. In addition, on the occasion of formation of a cholesteric-liquid-crystal polymer layer, the various additives which consist of a stabilizer or plasticizer metallurgy groups can be blended if needed.
[0026] A circular polarization of light detached core can also be formed in drawing 2 like instantiation as a superposition layer of two-layer or the three or more-layer cholesteric-liquid-crystal polymer layers 21 and 22. Superposition-izing is more advantageous than the point of coping with the wavelength shift of the formation of an extensive wavelength region of isolation, or oblique-incidence light etc., and it is desirable to superimpose in the combination from which the main wavelength of the reflected light differs in that case.
[0027] That is, since it is less than the whole region of the light desired when applying to a liquid crystal display etc. also in the wavelength range, the wavelength region which is made to superimpose the cholesteric-liquid-crystal polymer layer from which selective reflection nature differs, and shows circular dichroism can be made to expand in such a case, although a limitation is located in the wavelength region which shows selective reflection nature (circular dichroism) and the limitation also has usually the case of the large range which reaches about 100nm wavelength region in the cholesteric-liquid-crystal polymer layer of a monolayer.
[0028] It is the combination which reflects the circular polarization of light of the same polarization direction, and the cholesteric-liquid-crystal polymer layer whose main wavelength of selective reflection is incidentally 300-900nm can be used in the combination from which the main wavelength of selective reflection differs, and the circular polarization of light detached core which can cover a light region by superimposing the 2-6 kinds can be formed efficiently.
[0029] In addition, it aims at loading of the polarization in the condition that it can prevent and use that the point made into combination although the circular polarization of light of the same aforementioned polarization direction is reflected will be in a polarization condition which arranges the phase condition of the circular polarization of light reflected on each class, and is different in each wavelength region.
[0030] In addition, although a thing proper as a cholesteric-liquid-crystal polymer may be used as described above, the wavelength region of selective reflection becomes large and the larger liquid crystal polymer of phase contrast can be used more preferably than points, such as allowances over relief of a number of layers, or the wavelength shift at the time of a large angle of visibility. Moreover, it is more desirable than the point of reducing the angular dependence of the color change by viewing-angle change that the main wavelength of selective reflection is overlapped one by one than a short thing, and arranges a quarter-wave length plate to the long wavelength side.
[0031] although a difference of the main wavelength of the selective reflection in said cholesteric-liquid-crystal polymer carried out is based on a difference of the spiral pitch of clan JAN orientation -- this invention -- if -- you may be the circular polarization of light detached core of proper gestalten, such as a circular polarization of light detached core from which a spiral pitch changes in the thickness direction, and a circular polarization of light detached core from which the cholesteric-liquid-crystal polymer layer more than two-layer [of a spiral pitch difference] is overlapped as the sequence of merits and demerits based on the main wavelength of the reflected light, and a spiral pitch changes in the thickness direction.
[0032] The above mentioned spiral pitch of the structure of changing in the thickness direction is also effective in amplification of the wavelength region of selective reflection etc. In that case, the layer system to which the cholesteric-liquid-crystal polymer layer from which a spiral pitch differs between the cholesteric-liquid-crystal polymer layers of the same spiral pitch

contains the cholesteric-liquid-crystal polymer layer of the spiral pitch same like the thing of the gestalt which intervened one layer or more than two-layer more than two-layer as the sequence of the merits and demerits of said main wavelength is permitted.
[0033] In addition, actuation of pasting up the predetermined number of two sheets or three sheets or more of cholesteric-liquid-crystal polymer layers which carried out orientation processing, for example by thermocompression bonding etc. can perform manufacture of the circular polarization of light detached core from which the above-mentioned spiral pitch changes in the thickness direction. In thermocompression bonding processing, a method with the proper method which heats a cholesteric-liquid-crystal polymer layer under to isotropic phase transition temperature more than glass transition temperature, and carries out sticking-by-pressure processing through proper heating press means, such as a roll laminator, can be taken.
[0034] In the case of the flozen layer of the liquid crystal polymer which consists of an one object with a base material, the polarizing element by the circular polarization of light detached core from which a spiral pitch changes in the thickness direction, as a result this invention can be obtained by carrying out superposition processing according to the above so that the flozen layers may be close.
[0035] When said base materials 1 and 3 more than two-layer remain on the front reverse side of a polarizing element etc. like the instantiation to drawing 2 in the aforementioned case, as for support base materials 3 other than birefringence base material 1, it is more desirable than points, such as maintenance of visibility, to use that to which the phase contrast by the birefringence like a triacetyl cellulose film or an amorphous polyolefine film applied to the small former correspondingly as much as possible.
[0036] In addition, the circular polarization of light detached core from which a spiral pitch changes in the thickness direction may show the wavelength region of the continuous reflected light, and may show the wavelength region of the discontinuous reflected light. A circular polarization of light detached core more desirable than points, such as rainbow nonuniformity prevention, shows the wavelength region of the continuous reflected light.
[0037] Manufacture of the aforementioned circular polarization of light detached core can heat the superposition object of the cholesteric-liquid-crystal polymer layer formed by the thermocompression bonding actuation described above, for example under to isotropic phase transition temperature more than glass transition temperature, and can be performed by the approach of forming the orientation layer which the cholesteric-liquid-crystal polymer which forms an up-and-down layer in the adhesion interface mixed etc.
[0038] The cholesteric-liquid-crystal polymer layer in which the cholesteric-liquid-crystal polymer of an up-and-down layer was mixed, and was formed in the above forms the circular polarization of light detached core from which the spiral pitch differed also from the up-and-down layer, and the spiral pitch changed to the multistage story in the thickness direction, and the spiral pitch takes the mean value of the cholesteric-liquid-crystal polymer layer which forms an up-and-down layer, and forms usually the field which shows the wavelength region of the reflected light which continued with the up-and-down layer.
[0039] Therefore, when it uses in the combination of the cholesteric-liquid-crystal polymer layer which the wavelength region of the reflected light does not overlap in an up-and-down layer, i.e., the combination in which the lack region discontinuously called at the wavelength region of the reflected light exists, the cholesteric-liquid-crystal polymer layer formed of mixing of an up-and-down layer can fill said lack region, and can continuation-ize the wavelength region of the reflected light.
[0040] Therefore, for example, a reflected wave length region means that the circular polarization of light detached core reflected using two sorts of cholesteric-liquid-crystal polymer layers, a thing 500nm [or less] and a thing 600nm or more, also about the light of the 500-600nm wavelength region which is the non-contiguous areas of a reflected wave length

region can be obtained, and this can form the circular polarization of light detached core which is superposition of few cholesteric-liquid-crystal polymer layers, and shows the reflected wave length region of a wide band.
[0041] The polarizing element of this invention can be preferably used for formation of a liquid crystal display etc. In that case, a polarizing element can also be used as an optical element which added the quarter-wave length plate which becomes at least the one side from the phase contrast layer more than one layer or two-layer. The example of an optical element was shown in drawing 3 and drawing 4 . 4 is a quarter-wave length plate and 41 and 42 are phase contrast layers. Further 5 is a polarizing plate.
[0042] Like instantiation, a quarter-wave length plate is for linearly-polarized-light-izing the circular polarization of light which penetrated the circular polarization of light detached core 2, and is formed in drawing 3 and drawing 4 in the phase contrast layer more than one layer or two-layer. As for a quarter-wave length plate, it is more desirable than points, such as reduction of the angular dependence of the color change by viewing-angle change, to arrange to the long wavelength side of the main wavelength of the reflected light in a circular polarization of light detached core.
[0043] In the case of a light region, as a quarter-wave length plate (phase contrast layer), that whose transverse-plane phase contrast is 100-180nm is preferably used from points, such as linearly polarized light-ized effectiveness and compensation of the color change by the slanting transmitted light. That is, when the refractive index of ny and the thickness direction is set to nz and thickness is set to d for the refractive index of the direction which intersects perpendicularly the maximum refractive index within a field with nx and it, the quarter-wave length plate with which are satisfied of formula:(nx-ny) d=**nd=100-180nm is used preferably.
[0044] The phase contrast layer used if needed with the phase contrast layer which shows said quarter-wave length plate function It is made as much as possible in agreement with the color balance of the light which carried out the vertical transparency of the color balance of the light which carried out the slanting transparency of the phase contrast layer which shows a quarter-wave length plate function. It is [aiming at making the check by looking through a polarizing plate into neutral colors with more little coloring etc.] for compensation, and transverse-plane phase contrast (**nd) is desirable also 100-720nm, and it is used.
[0045] In addition, Nz of the phase contrast layer which can be used in the above more preferably than points, such as compensation of color change, to which the refractive index of the thickness direction is expressed with what is larger than that of one side of field inboard or both, or formula:(nx-nz)/(nx-ny) is especially 1.5 or less (all permit a minus value) thing two or less above all five or less.
[0046] As for a phase contrast layer, what may form with arbitrary construction material, is excellent in transparency, shows 80% or more of light transmittance above all, and gives uniform phase contrast is desirable. the oriented film which consists of a polymer generally illustrated with the above-mentioned birefringence base material, and a liquid crystal polymer -- the liquid crystal polymer of twist orientation etc. is used above all.
[0047] Control of properties, such as **nd, above mentioned Nz, an above mentioned refractive index of the thickness direction, etc., can be performed according to the case of the above-mentioned birefringence base material. Based on a monolayer object, 5-500 micrometers, above all, although especially the general thickness of a phase contrast layer is 20-200 micrometers, it is not limited to this 10-300 micrometers.
[0048] In addition, when forming phase contrast layers, such as a quarter-wave length plate, in a liquid crystal polymer, according to the case of the above-mentioned circular polarization of light detached core, it can obtain as what has a gestalt with the proper orientation layer of the liquid crystal polymer supported with the oriented film and transparence base material of a liquid crystal polymer etc. When a liquid crystal polymer is used, the target phase contrast layer can also be formed without drawing processing.

[0049] Like the above, the quarter-wave length plate may consist of a phase contrast layer of a monolayer, and may consist of a superposition object of the two-layer or the three or more-layer phase contrast layer from which phase contrast is different. Superposition-izing of the phase contrast layer from which phase contrast is different is effective in amplification of the wavelength range which functions as a target quarter-wave length plate and a target compensating plate etc. When considering as the superposition object of a phase contrast layer, it is more desirable than the point which arranging a phase contrast layer with the refractive index of the thickness direction higher than at least one side of the refractive index within a field one layer or more than two-layer described above.
[0050] An optical element more desirable than points, such as the improvement effectiveness of brightness, penetrates the linearly polarized light of a predetermined polarization shaft, and reflects the other light. An optical element can also be made into the gestalt which has arranged the polarizing plate 5 above the quarter-wave length plate 4 like instantiation to drawing 4 . In this case, it can apply to a liquid crystal cell as it is, without using a separate polarizing plate.
[0051] As a polarizing plate, what has the proper thing which prepared transparent protection layer can be used for the absorption mold polarizing plate which made the dichroism matter contain, a polyene oriented film, or the film concerned. Incidentally as an example of an absorption mold polarizing plate, the film which dichroism matter, such as iodine and dichromatic dye, was made to stick to the hydrophilic high polymer film like a polyvinyl alcohol system film, a partial formal-ized polyvinyl alcohol system film, and an ethylene-vinylacetate copolymer system partial saponification film, and was extended is raised. Moreover, as an example of a polyene oriented film, the dehydration processing object of polyvinyl alcohol, the demineralization acid-treatment object of a polyvinyl chloride, etc. are raised. In addition, although the thickness of a polarizing plate is 5-80 micrometers usually, it is not limited to this.
[0052] It is made to penetrate a polarizing plate, preventing an absorption loss for the light linearly-polarized-light-ized by altitude through the achievement nature, i.e., quarter-wave length plate, of a bright display in formation of a liquid crystal display as much as possible, and what has high degree of polarization is preferably used for it like the absorption mold polarizing plate of dichroism matter content etc. from the point of obtaining the display of the good contrast ratio by the incidence of the advanced linearly polarized light to a liquid crystal cell etc. Above all, the absorption mold polarizing plate of 99% or more of dichroism matter content is especially used [light transmittance] for degree of polarization preferably 95.0% or more at 40% or more.
[0053] Especially, the aforementioned transparent protection layer is prepared for the purpose of protection, when lacking in a water resisting property like the polarizing plate of dichroism matter content, and although it considered as the spreading method and film of plastics, it may be formed by the method with a proper laminating method etc. When forming by separation objects, such as a film, it is more desirable than points, such as prevention of a reflective loss, to carry out laminating unification by the glue line. The thickness of transparent protection layer may be determined suitably and, especially generally is set to 1-300 micrometers 500 micrometers or less above all 1mm or less. In addition, a proper thing may be used as plastics and the thing of instantiation etc. is raised with the above-mentioned birefringence base material etc.
[0054] In addition, a transparence resin layer can also be formed in the gestalt of surface detailed irregularity structure by the method which makes a particle contain. What shows transparency also for conductive things, such as the silica whose mean diameter is 0.5-5 micrometers, an alumina, a titania, a zirconia, tin oxide, indium oxide, cadmium oxide, and antimony oxide, in transparence resin layers, such as organic system particles, such as a certain inorganic system particle, and bridge formation or non-crosslinked polymer, is used for the particle. The content of a particle has 5 - 20 common % of the weight above all two to 25% of the weight.

[0055] Although it faces arranging a polarizing plate to the quarter-wave length plate up side and the arrangement include angle of the polarizing plate to a quarter-wave length plate can be suitably determined as the phase contrast property of a quarter-wave length plate, or it according to the property of the circular polarization of light which carries out incidence etc. It is more desirable than points, such as improvement in efficiency for light utilization, to arrange the transparency shaft of a polarizing plate to parallel as much as possible to the polarization direction (the oscillating direction) of the light linearly-polarized-light-ized through the quarter-wave length plate.
[0056] The optical element of this invention linearly-polarized-light-izes the circular polarization of light and elliptically polarized light which penetrated the polarizing element which divides the light from the light sources, such as the natural light, into the circular polarization of light on either side through an echo and transparency with a quarter-wave length plate, and enables it to supply them to a polarizing plate etc. Therefore, as illustrated to drawing 5 and drawing 6 , this polarizing element and optical element can be arranged on the proper surface light source 6 which has a reflecting layer at the rear face, such as a side light mold light guide plate and an EL lamp, and a lighting system suitable as a back light of a liquid crystal display etc. can be formed. In addition, the surface light source of the example of drawing comes to arrange the light source 62 on the side face of a light guide plate 6 in which it has a reflecting layer 61 at the rear face.
[0057] According to the lighting system of the example of said drawing, the light from the light source 62 carries out incidence to the side face of a light guide plate 6, outgoing radiation is carried out from the front face of a light guide plate through the echo in a rear face etc., and the outgoing radiation light penetrates the circular polarization of light detached core 2 arranged to the front-face side of a light guide plate as the predetermined circular polarization of light (vertical) and elliptically polarized light (slant), is linearly-polarized-light-ized through the quarter-wave length plate 4, and carries out incidence to a polarizing plate 5. On the other hand, it is reflected through the reflecting layer 61 which carried out re-incidence to the light guide plate 6 where a polarization condition is canceled through the birefringence base material 1, and has been arranged at the rear face, and incidence of the light reflected by the circular polarization of light detached core 2 as the circular polarization of light besides predetermined is again carried out to the circular polarization of light detached core 2 as a return light.
[0058] A polarization condition is canceled through the birefringence base material 1, and the reflected light by the aforementioned circular polarization of light detached core turns into the part and light in which the reflected light of abbreviation one half may penetrate a circular polarization of light detached core above all. Therefore, the reflected light by the circular polarization of light detached core is shut up between a circular polarization of light detached core and a light guide plate until it penetrates the circular polarization of light detached core, and it repeats an echo among them.
[0059] While the reflected light is shut up in a side light mold light guide plate like the above between a circular polarization of light detached core and the reflecting layer of a light guide plate and an echo is repeated by the meantime, a circular polarization of light detached core will be penetrated, outgoing radiation is carried out with the initial transmitted light of the incident light from the light source, and, thereby, the unused part of the light by the reflective loss is reduced.
[0060] On the other hand, the light which carried out outgoing radiation from the circular polarization of light detached core is changed into the linearly polarized light or elliptically polarized light with many linearly polarized light components through a quarter-wave length plate, a polarizing plate is penetrated without hardly absorbing this conversion light, when that direction of the linearly polarized light agrees with the transparency shaft of a polarizing plate, and, thereby, the unused part of the light by the absorption loss is also reduced. Consequently, in the former, the light used as a reflective loss or an absorption loss can also be used

effectively, and the utilization effectiveness of light can be raised. Therefore, as the surface light source, the light guide plate of a side light mold can use preferably.
[0061] The proper thing which has a reflecting layer at the rear face and was made to carry out outgoing radiation of the light to a front-face side as the aforementioned light guide plate can be used. Preferably, the thing which has absorption [be nothing] of light and which carries out outgoing radiation efficiently is used. (The cold, heat) A well-known side light mold back light etc. is the example in the liquid crystal display which arranges the light source of the linear light source of a cathode-ray tube etc., light emitting diode, etc. on the side face of a light guide plate 6, and was made to carry out outgoing radiation of the light transmitted to the light guide plate in the inside of a light guide plate to the one side side of a plate by diffusion, an echo and diffraction, interference, etc.
[0062] In the above, the light guide plate which was made to carry out outgoing radiation of the internal transmission light to an one side side can be obtained above all as concavo-convex structure, a thing which gave concavo-convex detailed prism array-like structure at what prepared diffuser in transparence, the optical outgoing radiation side of a translucent resin plate, or its rear face the shape of a dot, and in the shape of a stripe, and the rear face of a resin plate.
[0063] In addition, the reflecting layer 61 prepared in the rear face of a light guide plate is more effective than the point of preventing the incident light from the light source leaking from a rear face, and preventing a reflective loss nearly thoroughly with the echo of the return light through a polarizing element etc. A reflecting layer can be formed in the reflector where the specular reflection layer represented with the metal side which consists of vacuum evaporationo layers, such as the diffuse reflection layer and aluminum which are represented with a concavo-convex side etc., and silver, a resin plate which prepared it, a metallic foil, etc. is proper.
[0064] On the occasion of formation of a lighting system, like instantiation, one layer or more than two-layer are arranged if needed in predetermined locations, such as a vertical side of a light guide plate 6, and a side face, and auxiliary means, such as a light source holder for leading the diffusion plate for obtaining the prism array layer 7 which consists of a prism sheet for controlling the direction of outgoing radiation of light etc., and uniform luminescence, and the outgoing radiation light from a linear light source to the side face of a light guide plate, are used as a proper combination object at drawing 6 .
[0065] In the above, the dot given to the prism array layer arranged to the front-face side (optical outgoing radiation side) of a light guide plate, the diffusion plate, or the light guide plate may function also as a dissolution means of a polarization condition etc. by a spreading effect etc. In addition, when arranging the prism array layer more than two-layer, arranging in the condition that optical anisotropy is canceled is desirable by making the prism array in each class intersect perpendicularly thru/or cross, and being able to shift the arrangement include angle of an array.
[0066] In this invention, the laminating unification of each class which forms a polarizing element, an optical element, and a lighting system, such as a birefringence base material, a circular polarization of light detached core and a quarter-wave length plate, a polarizing plate, and a light guide plate, can be carried out through a glue line if needed. Laminating unification of the formative layer is effective in the lowering prevention of compensation effectiveness, polarization conversion efficiency, etc. by lowering prevention of display grace etc., and gap of optical system by trespass prevention of control of the reflective loss in respect of each field, the foreign matter to a field side, etc. Therefore, also when a birefringence base material, a circular polarization of light detached core and a quarter-wave length plate, a polarizing plate, a light guide plate, etc. are formed in two or more layers, respectively, it is desirable to carry out the adhesion unification of each class through a glue line etc.
[0067] The adhesive layer which is excellent in stress relaxation nature above all although proper adhesives etc. can be used for the aforementioned laminating unification controls the

stress produced with the heat from the light source etc. in a circular polarization of light detached core, a quarter-wave length plate, a polarizing plate, etc., change of the refractive index generated according to photoelasticity deformation is prevented, and it can use more preferably than the point which forms the liquid crystal display which is bright and is excellent in visibility or the dependability of display grace.

[0068] The transparent binder which comes to use proper polymers, such as for example, an acrylic polymer, a silicone system polymer and polyester, polyurethane and a polyether, and synthetic rubber, can be used for formation of an adhesive layer. Above all, an acrylic binder can use preferably from points, such as optical transparency, and an adhesion property, weatherability.

[0069] moreover, points, such as the tightness of the photoelasticity deformation by relaxation of the internal stress generated inside a layered product with heat as an adhesive layer, -- a relaxation modulus -- 2x105 - 1x107 dyne/cm2 -- the thing of 2x106 - 8x106 dyne/cm2 is desirable above all.

[0070] The thickness of an adhesive layer may be determined suitably. Especially generally 2-200-micrometer 1-500 micrometers are set to 5-100 micrometers above all from points, such as adhesive strength and thin-shape-izing. In addition, proper additives, such as the tackifier like petroleum system resin, rosin system resin, terpene system resin and cumarone indene system resin, phenol system resin and xylene system resin, and alkyd system resin, phthalic ester and phosphoric ester, chloroparaffin and polybutene, a softener like a polyisobutylene or other various bulking agents, and an antioxidant, can be blended with an adhesive layer if needed.

[0071] Formation of the optical element which carried out laminating unification carries out transfer of the adhesive layer which established Japanese tissue objects, such as a film, on the separator which comes to carry out surface treatment by the remover to the adhesion side of a polarizing element, a quarter-wave length plate is stuck by pressure on it, transfer of the adhesive layer is further carried out similarly on the quarter-wave length plate, and the method which arranges and sticks a polarizing plate by pressure on it is held.

[0072] Moreover, after carrying out transfer of the adhesive layer prepared in adhesion sides, such as a light guide plate, on the separator and arranging and sticking a polarizing element by pressure on it, The method which carries out transfer of the adhesive layer similarly on it, and carries out sequential sticking by pressure of a quarter-wave length plate or the polarizing plate as occasion demands, Or the laminating of the adherends, such as a polarizing element, a quarter-wave length plate and a polarizing plate, and a light guide plate, is carried out in predetermined sequence through the adhesive layer beforehand prepared in the predetermined adhesion side, and the method which carries out press processing and sticks it by pressure in package is held.

[0073] To the polarizing element by this invention, an optical element, and a lighting system, proper optical layers, such as an optical diffusion plate, can also be arranged in the proper location between the front face and layer. In that case, an optical layer may carry out laminating unification at a polarizing element etc. through the adhesive layer which is excellent in stress relaxation nature. This prior adhesion method has an advantage -- the component which is excellent in the dependability by which quality was stabilized rather than the sequential adhesion method in an assembly line is obtained.

[0074] In addition, in this invention, ultraviolet absorption ability can also be given with the method which processes components, such as a polarizing element, an optical element, the base material which forms a lighting system and a liquid crystal polymer layer, a quarter-wave length plate and a polarizing plate, a light guide plate, and a glue line, other optical layers, with ultraviolet ray absorbents, such as for example, a salicylate system compound, a benzo phenol system compound, a benzotriazol system compound, a cyanoacrylate system compound, and a nickel complex salt system compound.

[0075] As mentioned above the polarizing element and optical element of this invention A reflective loss is prevented by using in combination with the proper surface light sources, such as a side light mold light guide plate, carrying out the depolarization of the reflective circular polarization of light by the circular polarization of light detached core, and reusing as an outgoing radiation light. The absorption loss by the polarizing plate is prevented by changing into the condition that carry out phase control of the outgoing radiation light through a quarter-wave length plate, and the linearly polarized light component of polarizing plate permeability is included richly, and it enables it to aim at improvement in brightness.
[0076] Therefore, the light which is excellent in the utilization effectiveness of light and is easy to penetrate a polarizing plate is offered, and it can use for various equipments preferably as a back light system in a liquid crystal display etc. from large-area-izing etc. being easy. In that case, it is more desirable than the point of using the light which carried out outgoing radiation of the quarter-wave length plate as the light source that the linearly polarized light component which may penetrate a polarizing plate as a major-axis direction component of the linearly polarized light or elliptically polarized light etc. is included 70% or more above all 65% or more.
[0077] The liquid crystal display which used the lighting system by this invention for the back light system was illustrated to drawing 7 and drawing 8 . This arranges a liquid crystal cell 8 through an optical element to the optical outgoing radiation side side of the light guide plate 6 which forms a lighting system, and a liquid crystal cell 8 is arranged like the example of drawing at the quarter-wave length plate 4 side of an optical element. In addition, 81 are a polarizing plate and an optical diffusion plate for check-by-looking light diffusion in 9 among drawing.
[0078] The optical element and lighting system of this invention can be especially used for formation of the liquid crystal display which has a polarizing plate on both sides of a liquid crystal cell preferably. In addition, in the case of the optical element which has a polarizing plate to the quarter-wave length plate up side, the polarizing plate of the side which prepares the optical element in a liquid crystal cell is omissible.
[0079] A liquid crystal display is formed by assembling suitably component parts, such as a polarizing plate, a liquid crystal cell, a back light, and a phase contrast plate for compensation as occasion demands, and generally, incorporating an actuation circuit etc. Although there is especially no definition except for the point which arranges an optical element or a lighting system through a quarter-wave length plate side thru/or a polarizing plate side like the above in this invention to the check-by-looking tooth-back side of a liquid crystal cell and it can form according to the former, as for each component part, it is desirable that adhesion unification is carried out through an adhesive layer.
[0080] Moreover, although the optical element and lighting system of this invention can be preferably used for the thing using a liquid crystal cell with the need of carrying out incidence of the light of a polarization condition, for example, a twist nematic liquid crystal, and a super twist nematic liquid crystal etc., they can be used for the thing using the liquid crystal of the guest host system which distributed the liquid crystal and the dichroism matter of a non-twisting system in liquid crystal, or a ferroelectric liquid crystal etc.
[0081] On the occasion of formation of a liquid crystal display, proper optical layers, such as a phase contrast plate for compensation formed between the optical diffusion plate formed, for example on the polarizing plate by the side of a check by looking, an anti glare layer, an antireflection film and a protective layer, a guard plate or a liquid crystal cell, and polarizing plates, such as a check-by-looking side, can be arranged suitably.
[0082] The aforementioned phase contrast plate for compensation aims at compensating the wavelength dependency of a birefringence etc. and raising visibility etc. In this invention, it is arranged if needed between the polarizing plate by the side of a check by looking or/and a back light, and a liquid crystal cell etc. In addition, as a phase contrast plate for compensation, a proper thing can be used according to a wavelength region etc., and it may be formed as a superposition layer of the phase contrast layer more than one layer or two-layer. The phase

contrast plate for compensation can be obtained as an oriented film, a liquid crystal polymer layer, etc. of instantiation with the above-mentioned quarter-wave length plate.
[0083]
[Example]
To the polyvinyl alcohol rubbing processing side (about 0.1-micrometer thickness) established in the oriented film of 20 micrometers in thickness it is thin from an example 1PET film, Nz1.95, and the double refractive-index difference 0.090 within a field After carrying out coating of the 20-% of the weight tetrahydrofuran solution of an acrylic thermotropic cholesteric-liquid-crystal polymer with a wire bar and carrying out heating orientation processing for 5 minutes at 160 degrees C, it cools radiationally at a room temperature. The circular polarization of light detached core which reflects the right-handed circularly polarized light of 4 micrometers in thickness and 450-540nm of wavelength regions of selective reflection was formed.
[0084] On the other hand, on the polyvinyl alcohol rubbing processing side with a thickness of 50 micrometers which does not show a birefringence according to the above of a triacetic-acid cellulose film The circular polarization of light detached core with a thickness of 4 micrometers in which the wavelength region of selective reflection reflects the right-handed circularly polarized light by 570-650nm according to a difference of a meso gene ratio is formed. Liquid crystal polymer layers were piled up, the circular polarization of light detached core obtained above on it was introduced into the 130-degree C lamination roll, and the polarizing element which has the circular polarization of light detached core whose wavelength region of the selective reflection which consists of a superposition object which the liquid crystal polymer layer stuck is 450-650nm was obtained.
[0085] subsequently, after pasting up the quarter-wave length plate whose transverse-plane phase contrast which consists of an oriented film of a polycarbonate is 140nm through the acrylic adhesive layer with a thickness of 20 micrometers on the triacetic-acid cellulose film side (there are many spiral pitches of a circular polarization of light detached core -- it is -- a side) of said polarizing element and obtaining an optical element, it has been arranged on the surface light source through the PET oriented film side of said polarizing element, press sticking by pressure was carried out through the acrylic adhesive layer with a thickness of 20 micrometers, and the lighting system was obtained. In addition, the surface light source arranges a cold cathode tube with a diameter of 3mm on the side face of an acrylic light guide plate with a thickness of 4mm in which dot printing was performed to the rear face, surrounds it with a vacuum-plating-of-aluminium film, and consists of what prepared the reflective sheet which consists of foaming polyester film in said dot underside.
[0086] Replaced with the example 2PET oriented film, and the drawing polycarbonate film of Nz1.1, the double refractive-index difference 0.001 within a field, and 116nm of transverse-plane phase contrast was used, and also the polarizing element, the optical element, and the lighting system were obtained according to the example 1.
[0087] Replaced with the example 3PET oriented film, and the drawing polycarbonate film of Nz1.1, the double refractive-index difference 0.0045 within a field, and 270nm of transverse-plane phase contrast was used, and also the polarizing element, the optical element, and the lighting system were obtained according to the example 1.
[0088] As an example of comparison 1PET oriented film, the thing of Nz3.3 and the double refractive-index difference 0.073 within a field was used, and also the polarizing element, the optical element, and the lighting system were obtained according to the example 1.
[0089] The triacetic-acid cellulose film with a thickness of 50 micrometers in which a birefringence is not shown was used, and also it replaced with the example of comparison 2PET oriented film, and the polarizing element, the optical element, and the lighting system were obtained according to the example 1. Therefore, a polarizing element has the same triacetic-acid cellulose film as both sides.
[0090] While having arranged the TFT-liquid-crystal panel of marketing which has a polarizing

plate to both sides and measuring the brightness of the direction of a transverse plane (vertical) to the optical outgoing radiation side of the lighting system obtained in the assessment trial example and the example of a comparison (the TOPCON CORP. make, BM-5), visual observation of the visibility covering the direction of strabism of 45 right and left was carried out from the transverse plane. In addition, on the occasion of arrangement of a liquid crystal panel, the crossed axes angle of the drawing shaft of a quarter-wave length plate and the drawing shaft of a nearby polarizing plate was made into 45 degrees.

[0091] The aforementioned result was shown in degree table.

	実施例1	実施例2	実施例3	比較例1	比較例2
正面輝度(cd/m²)	353	333	330	354	353
視認性	良好	良好	良好	不良	良好

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the suitable polarizing element for improvement in the brightness of a liquid crystal display etc., an optical element, and a lighting system.
[0002]
[Background of the Invention] It separates into the circular polarization of light of right and left of the natural light through the polarizing element which comes to prepare the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer on a support base material, and the system which raises the brightness of a liquid crystal display is proposed by linearly-polarized-light-izing it through a quarter-wave length plate, and supplying a liquid crystal cell. A support base material is used for the purpose of orientation processing, reinforcement, etc. of a liquid crystal polymer layer.
[0003] Conventionally, as the aforementioned support base material, a small triacetyl cellulose film and a small glass plate were used for the birefringence as much as possible. While a birefringence disturbs a polarization condition and reducing the utilization effectiveness of light, it is because it becomes the cause by which the birefringence light which carried out the slanting transparency of the support base material makes a liquid crystal display generate rainbow nonuniformity, and reduces visibility. However, since there were problems, such as hygroscopicity, in ******** and a triacetyl cellulose film at a glass plate, the thickness and handling were regulated at the time of production of a polarizing element etc., and there was a trouble that the manufacture approach, a utilization gestalt, etc. were limited.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to the polarizing element of this invention, the polarization condition of the circular polarization of light which it was reflected by the circular polarization of light detached core based on the large birefringence property of a support base material, and carried out re-incidence to the support base material is cancelable. When the light is used as a lighting system, can shut up between the reflecting layer on the rear face of the surface light source, and a circular polarization of light detached core, and can carry out re-incidence to a circular polarization of light detached core repeatedly through a multiple echo, and it is used with light source light. A birefringence can attain the height of efficiency for light utilization and the lowness of rainbow nonuniformity which carry out an abbreviation even match to the polarizing element using a small support base material as much as possible. In the support base material of birefringence with which said polarization condition is not canceled, as described above, visibility falls greatly by generating of the rainbow nonuniformity by the birefringence light which carried out the slanting transparency of the support base material, and it is hard coming to penetrate a circular polarization of light detached core by survival of a polarization condition, and lowering of brightness becomes large.
[0008] On the other hand, by having permitted the birefringence, the support base material which has the physical properties made into the objects, such as the reinforcement and thermal resistance of an oriented film etc., and moisture resistance, can be used choosing it suitably, and a support base material can also be thin-film-ized. consequently, the liquid crystal display which regulation of the manufacture approach based on a support base material, a utilization gestalt, etc. is substantially eased, and is excellent in brightness or visibility -- manufacture -- it is stabilized efficiently and can obtain.
[0009]
[Embodiment of the Invention] When the polarizing element of this invention sets the refractive index of each direction of the lagging axis within a field, and a phase leading shaft to ns and nf and the refractive index of the thickness direction is set to nz, Nz defined by formula:(second-nz)/(second-nf) has the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer layer more than one layer or two-layer on 2.5 or less birefringence base material. The example was illustrated to drawing 1 and drawing 2 . For 1, a birefringence base material and 2 are [21 and 22] the cholesteric-liquid-crystal polymer layer in a circular polarization of light detached core. In addition, 3 is a support base material.
[0010] When the birefringence base material used in this invention sets the refractive index of each direction of the lagging axis within a field, and a phase leading shaft to ns and nf and the refractive index of the thickness direction is set to nz, Nz defined by formula:(second-nz)/(second-nf) is 2.5 or less thing. Making a circular polarization of light detached core easy for this to cancel a polarization condition and to penetrate, generating of the rainbow nonuniformity by the formation of the double refracted light of the light which carries out the slanting transparency of the base material can be prevented, and the liquid

crystal display which is excellent in the brightness which shows good visibility with the large angle of visibility of a transverse plane and the direction of slant can be formed.
[0011] Said Nz of a birefringence base material more desirable than points, such as generating prevention of the rainbow nonuniformity by the slanting transmitted light, is 2.0 or less thing above all 2.2 or less. In addition, that it is minus also permits the Nz value concerned. Moreover, rather than points, such as improvement in brightness, 0.09 or more birefringence base materials can use [the double refractive-index difference by (second-nf) of the definition by the above] preferably especially 0.07 or more above all 0.001 or more.
[0012] A birefringence base material can be formed with the proper ingredient in which the aforementioned birefringence property is shown, and its polymer film is more desirable than points, such as handling nature and filminess. The polymer film may be formed by proper methods, such as the casting method and an extrusion method, and may be an oriented film by proper mode of processing, such as one shaft and biaxial, and may be a non-extending film.
[0013] The above mentioned property control of Nz, a birefringence difference, etc. in a birefringence base material can be performed by changing conditions, such as construction material of a base material, such as crystallinity, thickness and draw magnification, and drawing temperature. Moreover, the method which carries out the heating drawing for example, of the polymer film under adhesion with a heat shrink nature film can perform control of the refractive index of the thickness direction.
[0014] Although the thickness of a birefringence base material can be suitably determined according to the purpose of use etc., especially generally it is set to 15-150 micrometers 10-200 micrometers above all 5-500 micrometers from points, such as reinforcement and thin-film-izing. In addition, a birefringence base material does not need to be a monolayer object and may be double **** like the film which laminated the different-species polymer for the various object, such as reinforcement and improvement in thermal resistance and the adhesion of a liquid crystal polymer.
[0015] In addition, what especially definition does not have about the aforementioned polymer which forms a birefringence base material, is excellent in transparency, and shows an equal birefringence is desirable. Incidentally as an example of the polymer, the thing of the polyolefine system like polyethylene or polypropylene, a norbornene system, a polyester system, a polyimide system, a polycarbonate system, a polyether sulphone system, a polysulfone system, a cellulose type, a polyarylate system, a polystyrene system, a polyvinyl alcohol system, a polyvinyl chloride system, a polyvinylidene chloride system, the Pori acrylic, a polyamide system, an epoxy system, and a liquid crystal polymer system etc. is raised. Above all, the polymer of a polyolefine system, a norbornene system, a polyester system and a polyimide system, a polycarbonate system and a polyether sulphone system, a polysulfone system and a cellulose type, a polyarylate system, or the Pori acrylic and an epoxy system can use preferably from points, such as moisture resistance, thermal resistance, reinforcement, or/and filminess.
[0016] A circular polarization of light detached core can be divided into the circular polarization of light on either side through an echo and transparency, and can form the natural light using a proper cholesteric-liquid-crystal polymer. The cholesteric-liquid-crystal polymer is excellent in the superposition effectiveness of a liquid crystal layer, the point of thin-film-izing, the point that change of the optical property to viewing-angle change can form a small liquid crystal display with a large angle of visibility, etc., and its large thing of a birefringence is more desirable than points, such as a size of the wavelength region of selective reflection, above all. A circular polarization of light detached core can be formed in the cholesteric-liquid-crystal polymer layer more than one layer or two-layer.
[0017] Incidentally as an example of a cholesteric-liquid-crystal polymer, the thing of the principal chain mold with which the straight-line-like atomic group (meso gene) of the conjugate property which gives a liquid crystal stacking tendency was introduced into the principal chain and side chain of a polymer, or a side-chain mold etc. is raised. Rather than points, such as

handling nature and the stability of the orientation in operating temperature, the cholesteric-liquid-crystal polymer whose glass transition temperature is 30-150 degrees C can use preferably. In addition, it has the structure which combined the meso gene radical which minds the spacer section which gives flexibility if needed as an example of said principal chain type of cholesteric-liquid-crystal polymer, and consists of a Para permutation ring compound etc., for example, polymers, such as a polyester system, a polyamide system, a polycarbonate system, and a polyester imide system, are raised.

[0018] Moreover, a thing, a nematic system liquid crystal polymer of low-molecular chiral agent content, a liquid crystal polymer of chiral component installation, a mixed liquid crystal polymer of a nematic system and a cholesteric system, etc. which have the low-molecular-liquid-crystal compound (meso gene section) which makes polyacrylate, polymethacrylate, a polysiloxane, poly malonate, etc. a principal chain frame, minds the spacer section which consists of an atomic group of conjugate property as a side chain as an example of the cholesteric-liquid-crystal polymer of a side-chain mold if needed, and consists of a Para permutation ring compound etc. are raised.

[0019] Like the above, it can consider as the thing of a cholesteric stacking tendency with the method which introduces the proper chiral component which consists of a compound which has asymmetrical carbon also in what has the Para permutation ring compound which gives the nematic stacking tendency which consists of the Para permutation aromatic-series unit, the Para permutation cyclohexyl ring unit, etc. like for example, an azomethine form, an azo form, an AZOKISHI form and an ester form, a biphenyl form and a phenylcyclohexane form, and a bicyclo hexane form, a low-molecular chiral agent, etc. (JP,55-21479,A, U.S. Pat. No. 5332522, etc.). In addition, a cyano group, the alkyl group, alkoxy group of the end substituent in the para position in the Para permutation ring compound, etc. may be proper.

[0020] Moreover, as the spacer section, for example, polymethylene chain-(CH2) n-, polyoxymethylene chain-(CH2CH2O) m-, etc. which show flexibility are raised. the chemical structure of the meso gene section etc. determines suitably the number of cycles of the structural unit which forms the spacer section -- having -- general -- the case of a polymethylene chain -- n -- 0-20, and the case where they are 2-12, and a polyoxymethylene chain above all -- m -- 0-10 -- it is 1-3 above all.

[0021] The polarizing element of this invention has the circular polarization of light detached core 2 which becomes drawing 1 and drawing 2 from the cholesteric-liquid-crystal polymer layers 21 and 22 more than one layer or two-layer on the birefringence base material 1 like instantiation. Although the formation can be performed by the approach of laminating for example, a birefringence base material and the film of a cholesteric-liquid-crystal polymer through a glue line if needed etc., it is performed by the approach of generally carrying out the coating attachment of the cholesteric-liquid-crystal polymer on a base material.

[0022] A circular polarization of light detached core is formed by carrying out orientation processing of the cholesteric-liquid-crystal polymer. The orientation processing can be performed by the approach according to conventional low-molecular liquid crystal. Incidentally as the example, film prepared on the base material, such as polyimide and polyvinyl alcohol, on the proper orientation film which consists of what carried out rubbing processing with the rayon cloth etc., a method vacuum evaporationo layer of slanting of SiO2, etc. A liquid crystal polymer is developed on the oriented film by drawing etc. Or more than glass transition temperature It heats under to isotropic phase transition temperature, after the liquid crystal polymer molecule has carried out GURANJAN orientation, it cools under to glass transition temperature, and it considers as a vitreous state, and the approach of forming the flozen layer by which the orientation concerned was fixed etc. is raised. In addition, the above-mentioned film of a liquid crystal polymer can obtain this flozen layer by exfoliating from a base material.

[0023] Also with a heating melting method, expansion of the aforementioned liquid crystal polymer is good, and can also be developed as a solution by the solvent. As the solvent, proper

things, such as a methylene chloride, a cyclohexanone and a trichloroethylene, tetrachloroethane and N-methyl pyrrolidone, and a tetrahydrofuran, can be used, for example.
[0024] The aforementioned expansion can be performed by proper approaches, such as a spin coat method, the roll coat method, the flow coat method and the printing method, a dip coating method and the flow casting forming-membranes method, the bar coat method, and gravure. On the occasion of expansion, the superposition method of the cholesteric-liquid-crystal polymer layer which minded the orientation film if needed etc. can be taken.
[0025] Especially the thickness of a cholesteric-liquid-crystal polymer layer has above all 3-20 micrometers more desirable than points, such as turbulence of orientation, prevention of permeability lowering, and selective reflection nature (wavelength range which shows circular dichroism), 1-50 micrometers 0.5-100 micrometers. In addition, on the occasion of formation of a cholesteric-liquid-crystal polymer layer, the various additives which consist of a stabilizer or plasticizer metallurgy groups can be blended if needed.
[0026] A circular polarization of light detached core can also be formed in drawing 2 like instantiation as a superposition layer of two-layer or the three or more-layer cholesteric-liquid-crystal polymer layers 21 and 22. Superposition-izing is more advantageous than the point of coping with the wavelength shift of the formation of an extensive wavelength region of isolation, or oblique-incidence light etc., and it is desirable to superimpose in the combination from which the main wavelength of the reflected light differs in that case.
[0027] That is, since it is less than the whole region of the light desired when applying to a liquid crystal display etc. also in the wavelength range, the wavelength region which is made to superimpose the cholesteric-liquid-crystal polymer layer from which selective reflection nature differs, and shows circular dichroism can be made to expand in such a case, although a limitation is located in the wavelength region which shows selective reflection nature (circular dichroism) and the limitation also has usually the case of the large range which reaches about 100nm wavelength region in the cholesteric-liquid-crystal polymer layer of a monolayer.
[0028] It is the combination which reflects the circular polarization of light of the same polarization direction, and the cholesteric-liquid-crystal polymer layer whose main wavelength of selective reflection is incidentally 300-900nm can be used in the combination from which the main wavelength of selective reflection differs, and the circular polarization of light detached core which can cover a light region by superimposing the 2-6 kinds can be formed efficiently.
[0029] In addition, it aims at loading of the polarization in the condition that it can prevent and use that the point made into combination although the circular polarization of light of the same aforementioned polarization direction is reflected will be in a polarization condition which arranges the phase condition of the circular polarization of light reflected on each class, and is different in each wavelength region.
[0030] In addition, although a thing proper as a cholesteric-liquid-crystal polymer may be used as described above, the wavelength region of selective reflection becomes large and the larger liquid crystal polymer of phase contrast can be used more preferably than points, such as allowances over relief of a number of layers, or the wavelength shift at the time of a large angle of visibility. Moreover, it is more desirable than the point of reducing the angular dependence of the color change by viewing-angle change that the main wavelength of selective reflection is overlapped one by one than a short thing, and arranges a quarter-wave length plate to the long wavelength side.
[0031] although a difference of the main wavelength of the selective reflection in said cholesteric-liquid-crystal polymer carried out is based on a difference of the spiral pitch of clan JAN orientation -- this invention -- if -- you may be the circular polarization of light detached core of proper gestalten, such as a circular polarization of light detached core from which a spiral pitch changes in the thickness direction, and a circular polarization of light detached core from which the cholesteric-liquid-crystal polymer layer more than two-layer [of a spiral pitch difference] is overlapped as the sequence of merits and demerits based on the main

wavelength of the reflected light, and a spiral pitch changes in the thickness direction.
[0032] The above mentioned spiral pitch of the structure of changing in the thickness direction is also effective in amplification of the wavelength region of selective reflection etc. In that case, the layer system to which the cholesteric-liquid-crystal polymer layer from which a spiral pitch differs between the cholesteric-liquid-crystal polymer layers of the same spiral pitch contains the cholesteric-liquid-crystal polymer layer of the spiral pitch same like the thing of the gestalt which intervened one layer or more than two-layer more than two-layer as the sequence of the merits and demerits of said main wavelength is permitted.
[0033] In addition, actuation of pasting up the predetermined number of two sheets or three sheets or more of cholesteric-liquid-crystal polymer layers which carried out orientation processing, for example by thermocompression bonding etc. can perform manufacture of the circular polarization of light detached core from which the above-mentioned spiral pitch changes in the thickness direction. In thermocompression bonding processing, a method with the proper method which heats a cholesteric-liquid-crystal polymer layer under to isotropic phase transition temperature more than glass transition temperature, and carries out sticking-by-pressure processing through proper heating press means, such as a roll laminator, can be taken.
[0034] In the case of the flozen layer of the liquid crystal polymer which consists of an one object with a base material, the polarizing element by the circular polarization of light detached core from which a spiral pitch changes in the thickness direction, as a result this invention can be obtained by carrying out superposition processing according to the above so that the flozen layers may be close.
[0035] When said base materials 1 and 3 more than two-layer remain on the front reverse side of a polarizing element etc. like the instantiation to drawing 2 in the aforementioned case, as for support base materials 3 other than birefringence base material 1, it is more desirable than points, such as maintenance of visibility, to use that to which the phase contrast by the birefringence like a triacetyl cellulose film or an amorphous polyolefine film applied to the small former correspondingly as much as possible.
[0036] In addition, the circular polarization of light detached core from which a spiral pitch changes in the thickness direction may show the wavelength region of the continuous reflected light, and may show the wavelength region of the discontinuous reflected light. A circular polarization of light detached core more desirable than points, such as rainbow nonuniformity prevention, shows the wavelength region of the continuous reflected light.
[0037] Manufacture of the aforementioned circular polarization of light detached core can heat the superposition object of the cholesteric-liquid-crystal polymer layer formed by the thermocompression bonding actuation described above, for example under to isotropic phase transition temperature more than glass transition temperature, and can be performed by the approach of forming the orientation layer which the cholesteric-liquid-crystal polymer which forms an up-and-down layer in the adhesion interface mixed etc.
[0038] The cholesteric-liquid-crystal polymer layer in which the cholesteric-liquid-crystal polymer of an up-and-down layer was mixed, and was formed in the above forms the circular polarization of light detached core from which the spiral pitch differed also from the up-and-down layer, and the spiral pitch changed to the multistage story in the thickness direction, and the spiral pitch takes the mean value of the cholesteric-liquid-crystal polymer layer which forms an up-and-down layer, and forms usually the field which shows the wavelength region of the reflected light which continued with the up-and-down layer.
[0039] Therefore, when it uses in the combination of the cholesteric-liquid-crystal polymer layer which the wavelength region of the reflected light does not overlap in an up-and-down layer, i.e., the combination in which the lack region discontinuously called at the wavelength region of the reflected light exists, the cholesteric-liquid-crystal polymer layer formed of mixing of an up-and-down layer can fill said lack region, and can continuation-ize the wavelength

region of the reflected light.
[0040] Therefore, for example, a reflected wave length region means that the circular polarization of light detached core reflected using two sorts of cholesteric-liquid-crystal polymer layers, a thing 500nm [or less] and a thing 600nm or more, also about the light of the 500-600nm wavelength region which is the non-contiguous areas of a reflected wave length region can be obtained, and this can form the circular polarization of light detached core which is superposition of few cholesteric-liquid-crystal polymer layers, and shows the reflected wave length region of a wide band.
[0041] The polarizing element of this invention can be preferably used for formation of a liquid crystal display etc. In that case, a polarizing element can also be used as an optical element which added the quarter-wave length plate which becomes at least the one side from the phase contrast layer more than one layer or two-layer. The example of an optical element was shown in drawing 3 and drawing 4 . 4 is a quarter-wave length plate and 41 and 42 are phase contrast layers. Further 5 is a polarizing plate.
[0042] Like instantiation, a quarter-wave length plate is for linearly-polarized-light-izing the circular polarization of light which penetrated the circular polarization of light detached core 2, and is formed in drawing 3 and drawing 4 in the phase contrast layer more than one layer or two-layer. As for a quarter-wave length plate, it is more desirable than points, such as reduction of the angular dependence of the color change by viewing-angle change, to arrange to the long wavelength side of the main wavelength of the reflected light in a circular polarization of light detached core.
[0043] In the case of a light region, as a quarter-wave length plate (phase contrast layer), that whose transverse-plane phase contrast is 100-180nm is preferably used from points, such as linearly polarized light-ized effectiveness and compensation of the color change by the slanting transmitted light. That is, when the refractive index of ny and the thickness direction is set to nz and thickness is set to d for the refractive index of the direction which intersects perpendicularly the maximum refractive index within a field with nx and it, the quarter-wave length plate with which are satisfied of formula:(nx-ny) d=**nd=100-180nm is used preferably.
[0044] The phase contrast layer used if needed with the phase contrast layer which shows said quarter-wave length plate function It is made as much as possible in agreement with the color balance of the light which carried out the vertical transparency of the color balance of the light which carried out the slanting transparency of the phase contrast layer which shows a quarter-wave length plate function. It is [aiming at making the check by looking through a polarizing plate into neutral colors with more little coloring etc.] for compensation, and transverse-plane phase contrast (**nd) is desirable also 100-720nm, and it is used.
[0045] In addition, Nz of the phase contrast layer which can be used in the above more preferably than points, such as compensation of color change, to which the refractive index of the thickness direction is expressed with what is larger than that of one side of field inboard or both, or formula:(nx-nz)/(nx-ny) is especially 1.5 or less (all permit a minus value) thing two or less above all five or less.
[0046] As for a phase contrast layer, what may form with arbitrary construction material, is excellent in transparency, shows 80% or more of light transmittance above all, and gives uniform phase contrast is desirable. the oriented film which consists of a polymer generally illustrated with the above-mentioned birefringence base material, and a liquid crystal polymer -- the liquid crystal polymer of twist orientation etc. is used above all.
[0047] Control of properties, such as **nd, above mentioned Nz, an above mentioned refractive index of the thickness direction, etc., can be performed according to the case of the above-mentioned birefringence base material. Based on a monolayer object, 5-500 micrometers, above all, although especially the general thickness of a phase contrast layer is 20-200 micrometers, it is not limited to this 10-300 micrometers.
[0048] In addition, when forming phase contrast layers, such as a quarter-wave length plate, in a

liquid crystal polymer, according to the case of the above-mentioned circular polarization of light detached core, it can obtain as what has a gestalt with the proper orientation layer of the liquid crystal polymer supported with the oriented film and transparence base material of a liquid crystal polymer etc. When a liquid crystal polymer is used, the target phase contrast layer can also be formed without drawing processing.

[0049] Like the above, the quarter-wave length plate may consist of a phase contrast layer of a monolayer, and may consist of a superposition object of the two-layer or the three or more-layer phase contrast layer from which phase contrast is different. Superposition-izing of the phase contrast layer from which phase contrast is different is effective in amplification of the wavelength range which functions as a target quarter-wave length plate and a target compensating plate etc. When considering as the superposition object of a phase contrast layer, it is more desirable than the point which arranging a phase contrast layer with the refractive index of the thickness direction higher than at least one side of the refractive index within a field one layer or more than two-layer described above.

[0050] An optical element more desirable than points, such as the improvement effectiveness of brightness, penetrates the linearly polarized light of a predetermined polarization shaft, and reflects the other light. An optical element can also be made into the gestalt which has arranged the polarizing plate 5 above the quarter-wave length plate 4 like instantiation to drawing 4 . In this case, it can apply to a liquid crystal cell as it is, without using a separate polarizing plate.

[0051] As a polarizing plate, what has the proper thing which prepared transparent protection layer can be used for the absorption mold polarizing plate which made the dichroism matter contain, a polyene oriented film, or the film concerned. Incidentally as an example of an absorption mold polarizing plate, the film which dichroism matter, such as iodine and dichromatic dye, was made to stick to the hydrophilic high polymer film like a polyvinyl alcohol system film, a partial formal-ized polyvinyl alcohol system film, and an ethylene-vinylacetate copolymer system partial saponification film, and was extended is raised. Moreover, as an example of a polyene oriented film, the dehydration processing object of polyvinyl alcohol, the demineralization acid-treatment object of a polyvinyl chloride, etc. are raised. In addition, although the thickness of a polarizing plate is 5-80 micrometers usually, it is not limited to this.

[0052] It is made to penetrate a polarizing plate, preventing an absorption loss for the light linearly-polarized-light-ized by altitude through the achievement nature, i.e., quarter-wave length plate, of a bright display in formation of a liquid crystal display as much as possible, and what has high degree of polarization is preferably used for it like the absorption mold polarizing plate of dichroism matter content etc. from the point of obtaining the display of the good contrast ratio by the incidence of the advanced linearly polarized light to a liquid crystal cell etc. Above all, the absorption mold polarizing plate of 99% or more of dichroism matter content is especially used [light transmittance] for degree of polarization preferably 95.0% or more at 40% or more.

[0053] Especially, the aforementioned transparent protection layer is prepared for the purpose of protection, when lacking in a water resisting property like the polarizing plate of dichroism matter content, and although it considered as the spreading method and film of plastics, it may be formed by the method with a proper laminating method etc. When forming by separation objects, such as a film, it is more desirable than points, such as prevention of a reflective loss, to carry out laminating unification by the glue line. The thickness of transparent protection layer may be determined suitably and, especially generally is set to 1-300 micrometers 500 micrometers or less above all 1mm or less. In addition, a proper thing may be used as plastics and the thing of instantiation etc. is raised with the above-mentioned birefringence base material etc.

[0054] In addition, a transparence resin layer can also be formed in the gestalt of surface detailed irregularity structure by the method which makes a particle contain. What shows transparency also for conductive things, such as the silica whose mean diameter is 0.5-5

micrometers, an alumina, a titania, a zirconia, tin oxide, indium oxide, cadmium oxide, and antimony oxide, in transparence resin layers, such as organic system particles, such as a certain inorganic system particle, and bridge formation or non-crosslinked polymer, is used for the particle. The content of a particle has 5 - 20 common % of the weight above all two to 25% of the weight.

[0055] Although it faces arranging a polarizing plate to the quarter-wave length plate up side and the arrangement include angle of the polarizing plate to a quarter-wave length plate can be suitably determined as the phase contrast property of a quarter-wave length plate, or it according to the property of the circular polarization of light which carries out incidence etc. It is more desirable than points, such as improvement in efficiency for light utilization, to arrange the transparency shaft of a polarizing plate to parallel as much as possible to the polarization direction (the oscillating direction) of the light linearly-polarized-light-ized through the quarter-wave length plate.

[0056] The optical element of this invention linearly-polarized-light-izes the circular polarization of light and elliptically polarized light which penetrated the polarizing element which divides the light from the light sources, such as the natural light, into the circular polarization of light on either side through an echo and transparency with a quarter-wave length plate, and enables it to supply them to a polarizing plate etc. Therefore, as illustrated to drawing 5 and drawing 6 , this polarizing element and optical element can be arranged on the proper surface light source 6 which has a reflecting layer at the rear face, such as a side light mold light guide plate and an EL lamp, and a lighting system suitable as a back light of a liquid crystal display etc. can be formed. In addition, the surface light source of the example of drawing comes to arrange the light source 62 on the side face of a light guide plate 6 in which it has a reflecting layer 61 at the rear face.

[0057] According to the lighting system of the example of said drawing, the light from the light source 62 carries out incidence to the side face of a light guide plate 6, outgoing radiation is carried out from the front face of a light guide plate through the echo in a rear face etc., and the outgoing radiation light penetrates the circular polarization of light detached core 2 arranged to the front-face side of a light guide plate as the predetermined circular polarization of light (vertical) and elliptically polarized light (slant), is linearly-polarized-light-ized through the quarter-wave length plate 4, and carries out incidence to a polarizing plate 5. On the other hand, it is reflected through the reflecting layer 61 which carried out re-incidence to the light guide plate 6 where a polarization condition is canceled through the birefringence base material 1, and has been arranged at the rear face, and incidence of the light reflected by the circular polarization of light detached core 2 as the circular polarization of light besides predetermined is again carried out to the circular polarization of light detached core 2 as a return light.

[0058] A polarization condition is canceled through the birefringence base material 1, and the reflected light by the aforementioned circular polarization of light detached core turns into the part and light in which the reflected light of abbreviation one half may penetrate a circular polarization of light detached core above all. Therefore, the reflected light by the circular polarization of light detached core is shut up between a circular polarization of light detached core and a light guide plate until it penetrates the circular polarization of light detached core, and it repeats an echo among them.

[0059] While the reflected light is shut up in a side light mold light guide plate like the above between a circular polarization of light detached core and the reflecting layer of a light guide plate and an echo is repeated by the meantime, a circular polarization of light detached core will be penetrated, outgoing radiation is carried out with the initial transmitted light of the incident light from the light source, and, thereby, the unused part of the light by the reflective loss is reduced.

[0060] On the other hand, the light which carried out outgoing radiation from the circular polarization of light detached core is changed into the linearly polarized light or elliptically

polarized light with many linearly polarized light components through a quarter-wave length plate, a polarizing plate is penetrated without hardly absorbing this conversion light, when that direction of the linearly polarized light agrees with the transparency shaft of a polarizing plate, and, thereby, the unused part of the light by the absorption loss is also reduced. Consequently, in the former, the light used as a reflective loss or an absorption loss can also be used effectively, and the utilization effectiveness of light can be raised. Therefore, as the surface light source, the light guide plate of a side light mold can use preferably.

[0061] The proper thing which has a reflecting layer at the rear face and was made to carry out outgoing radiation of the light to a front-face side as the aforementioned light guide plate can be used. Preferably, the thing which has absorption [be nothing] of light and which carries out outgoing radiation efficiently is used. (The cold, heat) A well-known side light mold back light etc. is the example in the liquid crystal display which arranges the light source of the linear light source of a cathode-ray tube etc., light emitting diode, etc. on the side face of a light guide plate 6, and was made to carry out outgoing radiation of the light transmitted to the light guide plate in the inside of a light guide plate to the one side side of a plate by diffusion, an echo and diffraction, interference, etc.

[0062] In the above, the light guide plate which was made to carry out outgoing radiation of the internal transmission light to an one side side can be obtained above all as concavo-convex structure, a thing which gave concavo-convex detailed prism array-like structure at what prepared diffuser in transparence, the optical outgoing radiation side of a translucent resin plate, or its rear face the shape of a dot, and in the shape of a stripe, and the rear face of a resin plate.

[0063] In addition, the reflecting layer 61 prepared in the rear face of a light guide plate is more effective than the point of preventing the incident light from the light source leaking from a rear face, and preventing a reflective loss nearly thoroughly with the echo of the return light through a polarizing element etc. A reflecting layer can be formed in the reflector where the specular reflection layer represented with the metal side which consists of vacuum evaporationo layers, such as the diffuse reflection layer and aluminum which are represented with a concavo-convex side etc., and silver, a resin plate which prepared it, a metallic foil, etc. is proper.

[0064] On the occasion of formation of a lighting system, like instantiation, one layer or more than two-layer are arranged if needed in predetermined locations, such as a vertical side of a light guide plate 6, and a side face, and auxiliary means, such as a light source holder for leading the diffusion plate for obtaining the prism array layer 7 which consists of a prism sheet for controlling the direction of outgoing radiation of light etc., and uniform luminescence, and the outgoing radiation light from a linear light source to the side face of a light guide plate, are used as a proper combination object at drawing 6 .

[0065] In the above, the dot given to the prism array layer arranged to the front-face side (optical outgoing radiation side) of a light guide plate, the diffusion plate, or the light guide plate may function also as a dissolution means of a polarization condition etc. by a spreading effect etc. In addition, when arranging the prism array layer more than two-layer, arranging in the condition that optical anisotropy is canceled is desirable by making the prism array in each class intersect perpendicularly thru/or cross, and being able to shift the arrangement include angle of an array.

[0066] In this invention, the laminating unification of each class which forms a polarizing element, an optical element, and a lighting system, such as a birefringence base material, a circular polarization of light detached core and a quarter-wave length plate, a polarizing plate, and a light guide plate, can be carried out through a glue line if needed. Laminating unification of the formative layer is effective in the lowering prevention of compensation effectiveness, polarization conversion efficiency, etc. by lowering prevention of display grace etc., and gap of optical system by trespass prevention of control of the reflective loss in respect of each field, the foreign matter to a field side, etc. Therefore, also when a birefringence base material, a

circular polarization of light detached core and a quarter-wave length plate, a polarizing plate, a light guide plate, etc. are formed in two or more layers, respectively, it is desirable to carry out the adhesion unification of each class through a glue line etc.

[0067] The adhesive layer which is excellent in stress relaxation nature above all although proper adhesives etc. can be used for the aforementioned laminating unification controls the stress produced with the heat from the light source etc. in a circular polarization of light detached core, a quarter-wave length plate, a polarizing plate, etc., change of the refractive index generated according to photoelasticity deformation is prevented, and it can use more preferably than the point which forms the liquid crystal display which is bright and is excellent in visibility or the dependability of display grace.

[0068] The transparent binder which comes to use proper polymers, such as for example, an acrylic polymer, a silicone system polymer and polyester, polyurethane and a polyether, and synthetic rubber, can be used for formation of an adhesive layer. Above all, an acrylic binder can use preferably from points, such as optical transparency, and an adhesion property, weatherability.

[0069] moreover, points, such as the tightness of the photoelasticity deformation by relaxation of the internal stress generated inside a layered product with heat as an adhesive layer, -- a relaxation modulus -- 2x105 - 1x107 dyne/cm2 -- the thing of 2x106 - 8x106 dyne/cm2 is desirable above all.

[0070] The thickness of an adhesive layer may be determined suitably. Especially generally 2-200-micrometer 1-500 micrometers are set to 5-100 micrometers above all from points, such as adhesive strength and thin-shape-izing. In addition, proper additives, such as the tackifier like petroleum system resin, rosin system resin, terpene system resin and cumarone indene system resin, phenol system resin and xylene system resin, and alkyd system resin, phthalic ester and phosphoric ester, chloroparaffin and polybutene, a softener like a polyisobutylene or other various bulking agents, and an antioxidant, can be blended with an adhesive layer if needed.

[0071] Formation of the optical element which carried out laminating unification carries out transfer of the adhesive layer which established Japanese tissue objects, such as a film, on the separator which comes to carry out surface treatment by the remover to the adhesion side of a polarizing element, a quarter-wave length plate is stuck by pressure on it, transfer of the adhesive layer is further carried out similarly on the quarter-wave length plate, and the method which arranges and sticks a polarizing plate by pressure on it is held.

[0072] Moreover, after carrying out transfer of the adhesive layer prepared in adhesion sides, such as a light guide plate, on the separator and arranging and sticking a polarizing element by pressure on it, The method which carries out transfer of the adhesive layer similarly on it, and carries out sequential sticking by pressure of a quarter-wave length plate or the polarizing plate as occasion demands, Or the laminating of the adherends, such as a polarizing element, a quarter-wave length plate and a polarizing plate, and a light guide plate, is carried out in predetermined sequence through the adhesive layer beforehand prepared in the predetermined adhesion side, and the method which carries out press processing and sticks it by pressure in package is held.

[0073] To the polarizing element by this invention, an optical element, and a lighting system, proper optical layers, such as an optical diffusion plate, can also be arranged in the proper location between the front face and layer. In that case, an optical layer may carry out laminating unification at a polarizing element etc. through the adhesive layer which is excellent in stress relaxation nature. This prior adhesion method has an advantage -- the component which is excellent in the dependability by which quality was stabilized rather than the sequential adhesion method in an assembly line is obtained.

[0074] In addition, in this invention, ultraviolet absorption ability can also be given with the method which processes components, such as a polarizing element, an optical element, the base

material which forms a lighting system and a liquid crystal polymer layer, a quarter-wave length plate and a polarizing plate, a light guide plate, and a glue line, other optical layers, with ultraviolet ray absorbents, such as for example, a salicylate system compound, a benzo phenol system compound, a benzotriazol system compound, a cyanoacrylate system compound, and a nickel complex salt system compound.

[0075] As mentioned above the polarizing element and optical element of this invention A reflective loss is prevented by using in combination with the proper surface light sources, such as a side light mold light guide plate, carrying out the depolarization of the reflective circular polarization of light by the circular polarization of light detached core, and reusing as an outgoing radiation light. The absorption loss by the polarizing plate is prevented by changing into the condition that carry out phase control of the outgoing radiation light through a quarter-wave length plate, and the linearly polarized light component of polarizing plate permeability is included richly, and it enables it to aim at improvement in brightness.

[0076] Therefore, the light which is excellent in the utilization effectiveness of light and is easy to penetrate a polarizing plate is offered, and it can use for various equipments preferably as a back light system in a liquid crystal display etc. from large-area-izing etc. being easy. In that case, it is more desirable than the point of using the light which carried out outgoing radiation of the quarter-wave length plate as the light source that the linearly polarized light component which may penetrate a polarizing plate as a major-axis direction component of the linearly polarized light or elliptically polarized light etc. is included 70% or more above all 65% or more.

[0077] The liquid crystal display which used the lighting system by this invention for the back light system was illustrated to drawing 7 and drawing 8 . This arranges a liquid crystal cell 8 through an optical element to the optical outgoing radiation side side of the light guide plate 6 which forms a lighting system, and a liquid crystal cell 8 is arranged like the example of drawing at the quarter-wave length plate 4 side of an optical element. In addition, 81 are a polarizing plate and an optical diffusion plate for check-by-looking light diffusion in 9 among drawing.

[0078] The optical element and lighting system of this invention can be especially used for formation of the liquid crystal display which has a polarizing plate on both sides of a liquid crystal cell preferably. In addition, in the case of the optical element which has a polarizing plate to the quarter-wave length plate up side, the polarizing plate of the side which prepares the optical element in a liquid crystal cell is omissible.

[0079] A liquid crystal display is formed by assembling suitably component parts, such as a polarizing plate, a liquid crystal cell, a back light, and a phase contrast plate for compensation as occasion demands, and generally, incorporating an actuation circuit etc. Although there is especially no definition except for the point which arranges an optical element or a lighting system through a quarter-wave length plate side thru/or a polarizing plate side like the above in this invention to the check-by-looking tooth-back side of a liquid crystal cell and it can form according to the former, as for each component part, it is desirable that adhesion unification is carried out through an adhesive layer.

[0080] Moreover, although the optical element and lighting system of this invention can be preferably used for the thing using a liquid crystal cell with the need of carrying out incidence of the light of a polarization condition, for example, a twist nematic liquid crystal, and a super twist nematic liquid crystal etc., they can be used for the thing using the liquid crystal of the guest host system which distributed the liquid crystal and the dichroism matter of a non-twisting system in liquid crystal, or a ferroelectric liquid crystal etc.

[0081] On the occasion of formation of a liquid crystal display, proper optical layers, such as a phase contrast plate for compensation formed between the optical diffusion plate formed, for example on the polarizing plate by the side of a check by looking, an anti glare layer, an antireflection film and a protective layer, a guard plate or a liquid crystal cell, and polarizing plates, such as a check-by-looking side, can be arranged suitably.

[0082] The aforementioned phase contrast plate for compensation aims at compensating the

wavelength dependency of a birefringence etc. and raising visibility etc. In this invention, it is arranged if needed between the polarizing plate by the side of a check by looking or/and a back light, and a liquid crystal cell etc. In addition, as a phase contrast plate for compensation, a proper thing can be used according to a wavelength region etc., and it may be formed as a superposition layer of the phase contrast layer more than one layer or two-layer. The phase contrast plate for compensation can be obtained as an oriented film, a liquid crystal polymer layer, etc. of instantiation with the above-mentioned quarter-wave length plate.

[Translation done.]

TECHNICAL PROBLEM

[The technical technical problem of invention] Maintaining the height of efficiency for light utilization and the lowness of rainbow nonuniformity by the polarizing element which used the small support base material as much as possible, this invention develops the polarizing element which can use the support base material according to the manufacture approaches, such as an oriented film which is excellent in many physical properties, such as reinforcement, thermal resistance, and moisture resistance, a utilization gestalt, etc., and a birefringence makes it a technical problem to obtain the liquid crystal display which is excellent in brightness or visibility.

[Translation done.]

MEANS

[Means for Solving the Problem] This invention offers the polarizing element characterized by Nz defined by formula:(second-nz)/(second-nf) having the circular polarization of light detached core which consists of a cholesteric-liquid-crystal polymer layer more than one layer or two-layer on 2.5 or less birefringence base material, when the refractive index of each direction of the lagging axis within a field and a phase leading shaft is set to ns and nf and the refractive index of the thickness direction is set to nz.
[0006] Moreover, the quarter-wave length plate with which this invention consists of a phase contrast layer more than one layer or two-layer on the circular polarization of light detached core in the aforementioned polarizing element, The optical element characterized by having the polarizing plate of dichroism matter content if needed on it, And the lighting system characterized by having an aforementioned polarizing element or an aforementioned optical element through the circular polarization of light detached core side on the surface light source which has a reflecting layer at the rear face, and the liquid crystal display characterized by having a liquid crystal cell through a polarizing plate at the optical outgoing radiation side of the lighting system in a list are offered. It is.

[Translation done.]

EXAMPLE

[Example]
After carrying out coating of the 20-% of the weight tetrahydrofuran solution of an acrylic thermotropic cholesteric-liquid-crystal polymer to the polyvinyl alcohol rubbing processing side (about 0.1-micrometer thickness) established in the oriented film of 20 micrometers in thickness it is thin from an example 1PET film, Nz1.95, and the double refractive-index difference 0.090 within a field with a wire bar and carrying out heating orientation processing for 5 minutes at 160 degrees C, it cools radiationally at a room temperature. The circular polarization of light detached core which reflects the right-handed circularly polarized light of 4 micrometers in thickness and 450-540nm of wavelength regions of selective reflection was formed.
[0084] On the other hand, it is a difference of a meso gene ratio on the polyvinyl alcohol rubbing processing side with a thickness of 50 micrometers which does not show a birefringence according to the above of a triacetic-acid cellulose film. The wavelength region of selective reflection formed the circular polarization of light detached core with a thickness of 4 micrometers which reflects the right-handed circularly polarized light by 570-650nm, liquid crystal polymer layers were piled up, the circular polarization of light detached core obtained above on it was introduced into the 130-degree C lamination roll, and the polarizing element which has the circular polarization of light detached core whose wavelength region of the selective reflection which consists of a superposition object which the liquid crystal polymer layer stuck is 450-650nm was obtained.
[0085] subsequently, after pasting up the quarter-wave length plate whose transverse-plane phase contrast which consists of an oriented film of a polycarbonate is 140nm through the acrylic adhesive layer with a thickness of 20 micrometers on the triacetic-acid cellulose film side (there are many spiral pitches of a circular polarization of light detached core -- it is -- a side) of said polarizing element and obtaining an optical element, it has been arranged on the surface light source through the PET oriented film side of said polarizing element, press sticking by pressure was carried out through the acrylic adhesive layer with a thickness of 20 micrometers, and the lighting system was obtained. In addition, the surface light source arranges a cold cathode tube with a diameter of 3mm on the side face of an acrylic light guide plate with a thickness of 4mm in which dot printing was performed to the rear face, surrounds it with a vacuum-plating-of-aluminium film, and consists of what prepared the reflective sheet which consists of foaming polyester film in said dot underside.
[0086] Replaced with the example 2PET oriented film, and the drawing polycarbonate film of Nz1.1, the double refractive-index difference 0.001 within a field, and 116nm of transverse-plane phase contrast was used, and also the polarizing element, the optical element, and the lighting system were obtained according to the example 1.
[0087] Replaced with the example 3PET oriented film, and the drawing polycarbonate film of Nz1.1, the double refractive-index difference 0.0045 within a field, and 270nm of transverse-plane phase contrast was used, and also the polarizing element, the optical element,

and the lighting system were obtained according to the example 1.
[0088] As an example of comparison 1PET oriented film, the thing of Nz3.3 and the double refractive-index difference 0.073 within a field was used, and also the polarizing element, the optical element, and the lighting system were obtained according to the example 1.
[0089] The triacetic-acid cellulose film with a thickness of 50 micrometers in which a birefringence is not shown was used, and also it replaced with the example of comparison 2PET oriented film, and the polarizing element, the optical element, and the lighting system were obtained according to the example 1. Therefore, a polarizing element has the same triacetic-acid cellulose film as both sides.
[0090] While having arranged the TFT-liquid-crystal panel of marketing which has a polarizing plate to both sides and measuring the brightness of the direction of a transverse plane (vertical) to the optical outgoing radiation side of the lighting system obtained in the assessment trial example and the example of a comparison (the TOPCON CORP. make, BM-5), visual observation of the visibility covering the direction of strabism of 45 right and left was carried out from the transverse plane. In addition, on the occasion of arrangement of a liquid crystal panel, the crossed axes angle of the drawing shaft of a quarter-wave length plate and the drawing shaft of a nearby polarizing plate was made into 45 degrees.
[0091] The aforementioned result was shown in degree table.

	実施例1	実施例2	実施例3	比較例1	比較例2
正面輝度(cd/㎡)	353	333	330	354	353
視認性	良好	良好	良好	不良	良好

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The sectional view of the example of a polarizing element
[Drawing 2] The sectional view of other examples of a polarizing element
[Drawing 3] The sectional view of the example of an optical element
[Drawing 4] The sectional view of other examples of an optical element
[Drawing 5] The sectional view of the example of a lighting system
[Drawing 6] The sectional view of other examples of a lighting system
[Drawing 7] The sectional view of the example of a liquid crystal display
[Drawing 8] The sectional view of other examples of a liquid crystal display
[Description of Notations]
1: Birefringence base material
2: Circular polarization of light detached core
21 22: Cholesteric-liquid-crystal polymer layer
3: Support base material
4:1/4 wavelength plate
41 42: Phase contrast layer
5: Polarizing plate
6: Light guide plate (surface light source)
61: Reflecting layer
62: Light source
7: Prism array layer
8: Liquid crystal cell (liquid crystal display)
81: Polarizing plate

[Translation done.]

* NOTICES *

DRAWINGS

[Drawing 1]

[Drawing 3]

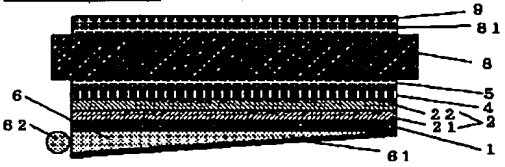
[Drawing 4]

[Drawing 2]

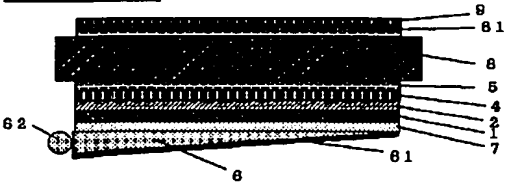
[Drawing 5]

[Drawing 6]

[Drawing 7]



[Drawing 8]



[Translation done.]